

1980

EXPLORATORY BEHAVIOUR AS A FUNCTION OF AROUSAL, PERCEPTUAL DEPRIVATION AND PERSONALITY DIFFERENCES.

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EXPLORATORY BEHAVIOUR AS A FUNCTION OF AROUSAL,
PERCEPTUAL DEPRIVATION AND PERSONALITY DIFFERENCES

by

Lawrence Gauzas

A Dissertation
submitted to the Faculty of Graduate Studies
through the Department of Psychology
in Partial Fulfillment of the
requirements for the Degree
of Doctor of Philosophy at The
University of Windsor

Windsor, Ontario, Canada

1980

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ABSTRACT

EXPLORATORY BEHAVIOUR AS A FUNCTION OF AROUSAL PERCEPTUAL DEPRIVATION AND PERSONALITY DIFFERENCES

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This study investigated the effects of arousal, brief perceptual deprivation and personality differences on exploratory behaviour.

Two experiments were done. In each, 60 subjects were presented with 15 preselected slides of non-representational art: five at each of three complexity levels. In Experiment I the subjects, divided into 3 groups, received 0, 30 or 60 seconds of visual deprivation (darkness) prior to viewing each slide. Measures of exploration included looking time for half the subjects and ratings of complexity, interestingness, pleasingness and arousal for the other half. In addition, each of the subjects filled out Eysenck's Extraversion Scale and Zuckerman's Sensation Seeking Scale (Form V).

In the second experiment two groups of subjects received a 100 dB 5 second burst of white noise either 15 (Pre "15") or 0 (Pre "0") seconds prior to viewing each slide. Another group received the noise concurrently with the slides. The control group from Experiment I

served as a control in this experiment as well. Once again each of the groups were divided into a looking time group and a rating group. The same measures of exploration and personality were used.

The results of the deprivation experiment suggested that looking time would increase significantly as a result of deprivation, with the greatest increases occurring for the 60 second deprivation group. The results also showed that a shift in the direction of increased judged complexity occurred at the high complex level. Increases in rated pleasingness were found at all three complexity levels. In all cases the rating shifts were greater for the 60 sec deprivation group.

The results of the second experiment suggested that looking time would decrease significantly with an increase in arousal, with concurrent stimulation producing the greatest decrements in looking time. Pleasingness ratings were found to decrease significantly at the mid and high complexity levels of the Pre '0' group, and at all complexity levels of the concurrent group. The downward shifts in pleasingness were found to be greatest for the concurrent group.

With respect to personality measures, it was found that high sensation seekers spent a greater proportion of their time fixating the high complex slides than the

low sensation seekers. The inverse of this was found for the low complex slides. High sensation seekers rated the high complex slides as being more pleasing than the low complex slides. Insufficient data for low sensation seekers did not permit an accurate comparison with high sensation seekers.

The Extraversion scale (E-scale) was found to correlate positively with the Sensation Seeking Scale, however, no apparent relationships between the E-scale and the measures of exploration employed in this study were found.

Two theories which may account for the findings of this study - Berlyne's U-shaped function relating arousal to arousal potential and a linear function proposed by Fiski and Maddi (1961) and Zuckerman (1969) - were examined and discussed and it was concluded that the evidence did not support the U-shaped function. The possibility of two different functions with differing parameters was raised to account for changes stemming from brief and prolonged perceptual deprivation.

ACKNOWLEDGEMENTS

I would like to thank my Dissertation adviser Dr. T. Hirota for his generous allotment of time and his patience. The direction and guidance he provided is greatly appreciated. I also thank my committee members Dr. A.A. Smith and Dr. J. Cohen for their constructive criticisms and suggestions which helped broaden and improve this study. Appreciation is also extended to Dr. J. Crozier for taking the time to read the manuscript and serving on the committee.

Finally, my thanks must also go to my wife, Aliza, for being there when I needed her and providing an inexhaustible pool of motivation.

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CHAPTER 1

INTRODUCTION

During the past century research in psychology has expanded greatly as new areas began to be subjected to the rigors of experimental analysis. Surprisingly, one area, that of curiosity and exploration was almost completely disregarded by researchers. It was not until the 1950's that this area finally came under intensive scrutiny. A number of factors contributed to this increased awareness. Many researchers were finally beginning to pay attention to the fact that much of the behaviour of various organisms including man was directed not to the satisfaction of their biological needs and self-preservation but rather seemed to be directed toward the exploration of their environment and searching for new forms of stimulation. It became increasingly more obvious that modifications of the existing theories would be required to account for the reported results. Besides, any comprehensive theory of behaviour which was not able to explain exploratory behaviour would be seriously deficient.

Numerous attempts were made to explain exploratory behaviour. Pavlov (1927) was among the first to talk about the "investigatory reflex" and a change in

stimulation that elicits it. Berlyne (1950) first attempted to explain exploratory behaviour by the use of the concept of curiosity. Montgomery's (1953) exploratory drive concept and Harlow's (1950, 1953b) manipulation motive and visual exploratory drive were very similar to Berlyne's concept. Other theorists such as Myers and Miller (1954) adhered to the viewpoint that monotonous, unchanging stimulation evoked a boredom drive that could only be reduced by sensory variety. Glänzer's (1953) concept of stimulus satiation was very similar to this notion of a boredom drive although it was without a drive or energizing function.

A number of other theorists around the same time were focusing more on the concept of arousal. Hebb (1955) and Leuba (1955) argued that organisms behave in such a way as to maintain an optimal level of stimulation. Berlyne (1960, 1963) and Fiski and Maddi (1961) expanded on Hebb's and Leuba's arguments and advanced their own conceptual frameworks to explain exploratory behaviour.

An entirely different kind of conceptual framework emerged in the late forties and early fifties; Shannon and Weaver (1949) and Attneave (1954). It was based on information theory. The basic idea behind its use in relation to exploratory behaviour was the notion that an organism would act to reduce uncertainty and thus gain information about its environment in the process.

Attempts to understand exploratory behaviour have stimulated the examination of a number of relevant variables. Perhaps one of the more fruitful approaches has been the study of the relationship between stimulus complexity and exploration.

Before examining this relationship it may be helpful to briefly examine the concept of complexity itself. Despite its manipulation in numerous studies there has not been a general consensus on the specific definition of stimulus complexity. Attneave (1957) using randomly generated polygons defined complexity in terms of the number of turns or sides of the figure. The greater the number of turns the greater the complexity of the figure. Welsh (1959) used the concept of symmetry-assymetry in defining complexity such that assymetrical figures were considered more complex than symmetrical ones. Gotz (1968) defined subjective complexity as being negatively determined by redundancy. Berlyne (1960) considered complexity to refer to the amount of variety or diversity in a stimulus pattern. He outlined a number of properties on which the complexity of a given pattern would depend. He suggested that 'other things being equal, complexity increases with the number of distinguishable elements. If the number of elements is held constant, complexity increases with dissimilarity between elements and varies inversely with the degree to which several

elements are responded to as a unit.' He also acknowledged the fact that there would be inter subject differences such that a given stimulus may be seen to have different degrees of complexity for different individuals. Nevertheless he felt that there would be some correlation between them. Berlyne's definition is probably the most comprehensive. Regardless of this, researchers are still obliged to define the concept in terms of what they are trying to accomplish suggesting that a universal definition of the concept has yet to be adopted.

PREFERENCE FOR COMPLEXITY

Animal Studies

Animal research into exploratory behaviour, specifically investigations into preference for complexity suggest that animals prefer complex stimuli to simple ones. Krechevsky (1937) designed his Dashiell maze in such a way so as to give rats the opportunity of reaching the goal box either by an indirect route requiring more turns or by using a direct route with a minimum of turns. The results showed that normal rats tended to prefer the more complex indirect route. Montgomery (1954) using a Y-maze with one of the arms leading to a blind alley and the other to a Dashiell maze showed that rats preferred to go to the D-maze (the more complex alternative). Berlyne (1955) used a square

enclosure in which he introduced various objects. Rats spent more time investigating the part of the enclosure with numerous and complex stimuli. Dember, Earl, and Paradise (1957) found that rats that were allowed access to two contiguous circular pathways differing in visual complexity tended to select the more complex pathway. They also found that shifts in preference for the alternatives were always toward the one providing greater complexity. Welker (1956) found that chimps preferred to look at stimuli that were heterogeneous and changing rather than monotonous, unchanging stimulation.

Taylor (1974) describes an experiment in which rats, following extended exposure to a mid-complexity stimulus were allowed to choose between a stimulus change and the now familiar midcomplexity stimulus. For some Ss the change was to a stimulus of higher complexity, and for others the change was to a lower complexity stimulus. The results suggested that changes to a stimulus of greater complexity were preferred more than changes to a less complex stimulus.

Sackett (1966), working with infant rhesus monkeys which were exposed to differentially complex visual patterns, found that as the infant monkeys matured (Day 5 through 39 after birth) a gradual change in preference from simpler to more complex stimuli was observed.

Complexity as Reinforcement

A number of investigators have attempted using visual stimuli as the sole means of reinforcement and have obtained positive results. Butler (1954) testing monkeys on four incentive conditions of viewing and hearing another caged monkey, viewing and hearing a moving electric train, viewing various foods, and viewing an empty chamber, found that response frequency was highest for the monkey condition and decreased progressively for the other conditions with the empty chamber (the simplest stimulus) evoking the lowest response frequency.

Using a discrimination paradigm Berlyne and Slater (1957) as well as Montgomery and Segal (1959) showed that rats can readily learn a discrimination task when the only reinforcer was exposure to complex stimulation in the form of a complex maze. Barnes and Baron (1961) studied the reinforcing effects of response-contingent luminous patterns in mice in a lever-pressing situation. They found that increases in the complexity of the luminous patterns resulted in increases in the rate of responding. They concluded that response-contingent patterns are effective positive sensory reinforcers with the more complex patterns being the most effective reinforcers. Similarly, Misra and Patra (1975) found that complex visual stimuli may serve as effective reinforcers for

the rat in maintaining operant responses (looking through a window) for long periods of time.

To summarize, it can be said that the evidence clearly suggests that animals will generally spend more time investigating complex than simple stimuli. The evidence also suggests that they can learn discrimination tasks and maintain operant responses when the only reinforcer is a complex visual stimulus.

Human Studies

Research findings with human subjects parallel the findings of animal investigations. Berlyne (1958b) using visual fixation as a measure of preference in infants, found that the infants generally tended to fixate first on the more complex stimulus of a given pair. Cantor, Cantor, and Ditricks (1963) used preschool children who were presented with six stimulus triads one at a time. Each triad contained stimuli which were considered to be low, medium, and high in complexity level. Their results showed that the Ss spent more time, on the average, observing the high complexity stimuli as compared with the medium and low complexity stimuli. Brennan, Ames, and Moore (1966) presented 3, 8 and 14 week old infants with checkerboard patterns which differed in the number of squares they contained. Their results showed an interaction between age and preference for complexity such that the older the infants the more

complexity they preferred to look at. Willis and Dornbush (1968) presented 20 pairs of random visual patterns, varying in complexity from 3 to 8 sides, to subjects of 3 age levels: 5, 9, and 19 years. Each of the patterns was paired with a standard 4-sided figure and the subject had to choose 1 of the pair to look at again. Their results showed a tendency for the more complex of the pair to be chosen more frequently. Faw and Nunnally (1968) filmed their subjects' eyes while they viewed pairs of stimuli which varied in complexity. Their results showed that the children tended to fixate predominantly on the more complex of the figures. Strain (1968) examined children's preferences for color complexity. He presented to 3, 4, and 5 year old children stimulus trays which contained pieces of candy of 1, 2, or 4 colors. The subjects were presented with the 3 trays simultaneously and had to choose one candy on each trial. Strain found that on the average the children preferred to select from the 4 colour - more complex - tray. Unikel and Harris (1970) ran a similar study, however, they doubled the number of trials from 4 to 8. Their results were not as clear as those of Strain, showing some increases and decreases in preference for complexity from trial to trial. Nevertheless, the overall results suggest that the children preferred the more complex trays to the simpler

ones. Fouts (1974) placed 8 month old infants on each of 6 stimuli which varied in complexity and observed the effect that complexity had on the crawling of the infant to its mother. His results showed that ss tended to delay their approach to mother when they were placed on the more complexly patterned stimuli.

Faceness vs. Complexity

One area peculiar to research with human infants has stimulated a fair amount of interest. Fantz (1961) reported that infants from birth to six months of age tend to spend more time looking at a schematic drawing of a face than a scrambled version of the same drawing. This has led to the assumption that any stimulus containing facial features will be preferred by infants to any other stimulus equal in complexity. The validity of this assumption is questionable especially in light of the fact that Fantz did not perform any statistical analyses. Later studies (Fantz, 1966; Watson, 1966) obtained some support for this assumption but the age levels in the studies varied and were not consistent. Wilcox (1969) had 4, 10, and 16 week old infants view⁷ pictures of faces varying in complexity. She used a photograph, a realistic drawing, and schematic drawings of a complete, 3 incomplete, and a scrambled face. Her results suggested that the infants preferred more complex over less complex stimuli and no preference was evident

for the schematic over the symmetrically scrambled face. Generally, complexity was more important than "faceness" in determining preferences. Cummings (1975) using a scrambled and a regular cartoon face equated for complexity found that 4 month old infants preferred to look at the regular cartoon face. She concluded that social content (Human Face) was a more effective elicitor of attention than complexity (equally complex Scrambled Face). Haaf and Brown (1976) presented 10 and 15 week old infants six patterns which represented three levels of stimulus complexity as well as two different types of organization, facial features and scrambled facial components. At both ages the infants' fixation time was longer for higher levels of complexity. In addition the older infants, unlike the younger ones, showed a preference for the patterns with facial organization, the difference becoming more pronounced at higher levels of complexity.

The results of these studies are conflicting to a degree and it seems that the question of preference in this area is not completely answered. The differences obtained can probably be attributed to the variety of stimuli used, individual differences and the ages of the infants. It seems likely that a difference of a few weeks in the age of the subject may have a profound effect on the results.

Studies with adults are generally in agreement with those with infants and children. Adults also tend to prefer more complex visual stimuli to less complex ones. Gaschk, Kintz and Thompson (1968) found that subject spent more time looking at high complex stimulus slides than at low or medium complex slides. When the subjects were also allowed to physically handle the objects, there was an even greater difference between the amount devoted to complex as compared with less complex stimuli. Dent and Simmel (1968) showed pairs of cards differing in complexity to a group of subjects for 3 seconds. The subjects then had to choose one of each pair to look at again. The majority of subjects chose the more complex designs. Eisenman and Gellens (1968) exposed college students to polygons varying in complexity and symmetry. They were asked which of the polygons they preferred. The vast majority preferred complex symmetrical shapes. Berlyne (1972) investigating the reinforcement value of visual patterns used a procedure in which the subjects had to press keys which would periodically expose slides. The subjects' rate of responding was higher on the key that exposed the more complex pattern suggesting that it was a more reinforcing stimulus. Lemond et al., (1974) constructed stimuli (random geometric forms) to represent increasing levels of complexity. Using viewing time as a measure of

exploratory preference they found that the relationship between the level of stimulus complexity and viewing time was monotonic and increased with increases in complexity. Berlyne (1975) carried out a cross-cultural comparison using Canadian and Indian subjects.

Measures of looking-time, paired comparison preferences and rating scales were used. In all the groups tested, there was evidence of a tendency to look longer at more complex patterns suggesting that this tendency has cross-cultural validity and is not confined to Western subjects alone. Russell (1975) examined the relationship between looking time, response frequency, and rating scales using 21 visual stimuli. He found the three measures to be highly correlated. He also found that subjective complexity was positively related to looking time as well as to response frequency.

In summary, the evidence presented generally suggests that human subjects, both children and adults, prefer complex stimuli to simple ones. Symmetry also seems to play a role of some importance as subjects tend to prefer complex symmetrical stimuli. There is also some indication, in studies with infants, of a maturational effect with preference for complexity increasing with age. However, some results, particularly in studies with infants are conflicting due, in large part, to the methodological differences between them.

Complexity and Aesthetic Preference

The studies reviewed so far have all used artificial stimuli specifically prepared for the purpose of the experiments. As a result, the range of complexity used has generally not been particularly great. As well, since the stimuli were artificial the findings may not necessarily apply to more real-to-life stimuli.

A number of more recent studies have begun investigations of complexity as one aesthetic measure of preference for art to determine if the findings with artificial stimuli are generalizable. Wohlwill (1968) used slides made up of scenes from the geographic environment and of works of nonrepresentational modern art. He used frequency of exposure as a measure of exploratory behaviour and subjective ratings to measure preference. His results showed that frequency of exposure was a linearly increasing function of complexity for both types of slides. On the other hand the relationship between complexity and preference ratings was curvilinear, reaching a maximum at an intermediate level of complexity. Osborne and Farley (1970) compared art students with students not studying art on their preferences for complexity in abstract art. Their results showed that there was a significant relationship between rated visual complexity and aesthetic preference to the extent that both groups preferred high complexity.

Lindauer (1971) on the other hand, studied the effect of judged complexity on "liking" and looking time. He found no significant systematic relationship between these measures. Saklofske (1975a) examined the relationship between exploratory behaviour and stimulus complexity using 15 paintings at three different levels of complexity. He found that looking time varied directly with rated complexity. In another study Saklofske (1975b) used the same paintings to examine the relationship between attractiveness and complexity. His results showed an inverted U-shaped function between attractiveness and complexity such that Ss most often selected and least often rejected for further viewing paintings that were rated highly attractive and moderately complex. He reconciled the results of the two studies by referring to Berlyne's (1963) concepts of specific and diverse exploration. Specific exploration is motivated by curiosity and as a result would be reflected in increased looking time in relation to more complex stimuli. Diverse exploration, on the other hand, is aimed at producing or maintaining an optimal level of arousal and as a result, looking time would be greater for medium complexity levels than for either simple or complex stimuli. In a study by Nicki and Moss (1975) the investigators also examined preferences for non-representational art in relation to complexity using

frequency of exposure as the dependent measure. They found that preferences for the art works were generally linearly related to complexity. Breur and Lindauer (1976) had Ss rank or rate the complexity, preference, pleasingness and interestingness of 7 pairs of outline drawings of various buildings representative of a variety of architectural styles. They found a linear rather than a curvilinear relationship between the four measures with no sex differences. They concluded that "architectural stimuli are capable of evoking and sustaining a level of arousal which is both cognitively and affectively satisfying".

Overall most of the studies tend to support the findings with artificial stimuli and suggest that under normal conditions both animal and human subjects given a choice between simple and complex stimuli, tend to select the more complex alternatives. As far as the actual relationship between preference and complexity, the available research shows much less agreement on this point. Some studies suggest a linear (monotonically increasing) relationship between preference and complexity. (Breur & Lindauer, 1976; Lemond et al. 1974; Nicki & Moss, 1975; Saklofske, 1975a). Other studies show the relationship to be an inverted U, (Vitz, 1966a; Day, 1967; Berlyne, 1970; Wohwill, 1968; Saklofske, 1975b) or even a double inverted U-function

(Walker, 1973). Still others, (Lindauer, 1971), show no systematic relationship at all.

A number of factors may account for some of these differences. One factor would almost certainly have to be intersubject variability due possibly to individual personality differences. Another factor further compounding the difficulties is the great variety of stimulus materials used in different studies. As well, the definition of complexity and the complexity levels used vary from study to study. What one researcher considers a high level of complexity another may consider it to be medium or even low. As a result of these differences, direct comparisons between many of these studies are difficult to make.

Berlyne attempted to control for some of these problems by using the same stimuli in a series of studies. Generally, he was able to obtain relatively consistent results. However, as already mentioned, his stimuli were artificial and specifically constructed for his experiments. What is needed is more rigorous work with non artificial stimuli. Preferably, the same stimuli should be used under a variety of conditions. Only then can direct comparisons and more meaningful generalizations be made.

Arousal and Exploration

Several theorists (Fiske and Maddi, 1961; Berlyne, 1963; Schultz, 1965; Zuckerman, 1969) have maintained

that exploratory behaviour in man as well as other organisms may serve to increase stimulation and tension and may, therefore, be incompatible with a traditional drive reductionist viewpoint. Schultz has gone as far as to argue that "man has a need for sensory stimulation, without which adaptive behaviour is not possible." (1965, p. 13). On the basis of experimental findings Schultz (1965), Fiski and Maddi (1961), Berlyne (1963) among others have proposed that there is an optimal range of sensory stimulation for positive affect or adaptive functioning in organisms.

The concept of arousal plays an extremely important role in optimal stimulation theory since it is considered to be an underlying factor in the variable need for stimulation. In optimal stimulation theory, cortical arousal determines the effectiveness of learning, the performance of responses, the maintenance of positive emotional tone and adaptation to the environment in general. As well, these theorists have argued that arousal is directly influenced by sensory stimulation. As a result, organisms engage in activities which increase or decrease levels of sensory stimulation in order to maintain optimum levels of arousal.

A number of investigators have examined the effect of heightened arousal on exploratory behaviour.

In experiments with animals, level of arousal was generally varied through manipulating changes in drive states such as hunger or thirst, or by the use of intense white noise or electric shock. Change in exploratory behaviour as a result of these variations was then measured. A typical study is one by Haywood & Wachs (1967). They habituated rats to one arm of a Y-maze, then exposed them to conditions of intense white noise, electric shock, shock incongruity or no arousing stimulation. The rats were then allowed free choice to enter the novel or familiar maze arm. They found that under all conditions of arousing stimulation preference for novelty was reduced to a chance level while in the non-arousing control condition, preference for novelty in the two choice situation was 79%.

In research ~~with human subjects~~ arousal was frequently raised by increasing psychological stress or anxiety by manipulating the instructions or by inducing frustration.

Smock (1956) found that subjects under psychological stress required more exposures in order to identify a picture.

McReynolds and Bryan (1956) using neuro-psychiatric patients manipulated the level of unassimilated percepts and found that patients in whom a higher level of anxiety was induced were less willing to expose themselves to

names of novel and unusual objects.

Haywood (1961), on the other hand, using normal college students, could find no support for the results of McReynold's and Bryan's study. His results showed a tendency for the group with a higher level of unassimilated percepts to make more novelty-seeking choices. The differences, however, were not significant. In a follow up study Haywood (1962) found that when he inserted an incomprehensible message during the course of a novelty choosing session the subjects significantly decreased the number of novel pictures they chose to look at. Both, subjects of low and high manifest anxiety produced these results.

Day (1965) attempted to raise arousal by inducing psychological stress, i.e., by manipulating the instructions he induced a fear of failure in his subjects. He failed to find any ~~changes~~ as a result of increased arousal. However, he did not attempt to measure the anxiety that was supposedly produced, leaving the possibility of an effective arousal increase open to doubt.

Leahy (1975) in an attempt to determine the effects of arousal on preference for complexity exposed infants under low and high hunger drive to different levels of complexity. His results showed that low-hunger Ss had longer fixation times than high-hunger Ss toward all

stimuli. They also showed relatively greater preference for complexity than high-hunger Ss.

White noise has also been shown to raise arousal in human subjects as manifested by effects on skin conductance (Berlyne & Lewis, 1963), on heart rate and verbal report (Thayer et al., 1970) as well as on averaged multiple-unit activity in the reticular formation (Podvoll & Goodman, 1967). In addition it has been found to produce effects comparable to those of other arousal-raising agents on exploratory behaviour (Berlyne & Lewis, 1963; Haywood & Wachs, 1967) on verbal learning (McLean, 1969) on field dependence (Oltman, 1964) and on motor performance (Weinstein & MacKenzie, 1966).

Berlyne and Lewis (1963) used white noise, shock expectation and threat of memory test to raise the level of arousal in their subjects. Their results showed that subjects under all three conditions of increased arousal chose significantly fewer high complexity figures to look at than did a control group. They also found that the subjects exposed themselves to all the patterns a greater number of times under the conditions of increased arousal.

Hockey (1973) examined changes in information selection patterns in a 3-source monitoring task as a function of an external source of arousal (valve noise).

He found changes in information-selection patterns to the extent that there was a monotonic increase in attentional selectivity with arousal.

A number of researchers (Evans, 1970; Berlyne, 1971; Nicki, 1972) using white noise failed to obtain predicted differences when compared with a no white noise condition.

Evans (1970) exposed his subjects to white noise to determine if increased arousal would result in greater question asking in response to a lower level of paragraph complexity. He failed to obtain any differences between the white noise and no white noise conditions. However, his procedure suggests that the white noise may not have been arousing by the time the experimental paragraphs were presented in view of the strong possibility of habituation.

Berlyne (1971) used white noise in the form of prechoice stimulation to raise arousal in his subjects. As a second prechoice condition, he used excerpts from a recorded story. His results showed that white noise did not lead to a reduction of the tendency to choose more complex patterns more often, but the recorded story condition did. He concluded that what distinguished the two sets of prechoice conditions was not arousal value, but the level of exteroceptive information processing just before the choice. However, recent work by Hallman

and Isaac (1977) suggests that Berlyne's white noise condition may not have been as arousing as he might have thought. In Berlyne's study the subjects received the white noise prestimulation in near darkness. Kallman and Isaac, however, investigating the effect of white noise on reaction time under different levels of ambient sensory stimulation found that white noise interacted with level of illumination. They found no differences between the noise and quiet conditions when the experiment was performed in darkness. However, significant differences were obtained under conditions of light. The effect of white noise in this situation was to increase response latencies. Thus it seems quite possible that Berlyne's ambient sensory conditions may have diminished the impact of the white noise.

Nicki (1972) also used white noise in an attempt to manipulate choice of complexity through increased arousal. He obtained a significant effect in only one of the groups. He does not report the ambient sensory conditions, however, so it is possible that in this experiment as well, the white noise may not have been sufficiently arousing.

Overall, although the results have not always been consistent the evidence has generally tended to support the optimal stimulation theories and suggests that changes in the level of arousal affect the level

of arousal potential to which the subject would be willing to expose himself or willing to tolerate. As far as those studies that failed to obtain differences as a function of arousal, their results may in all probability be attributed to the variety of response measures used, the amount of increase in arousal above the optimum, or the procedures used to induce arousal itself. Despite their methodological inadequacies these studies do, nevertheless, give rise to a number of questions that have been dealt with only superficially or not at all. Of particular interest are questions dealing with the timing and duration of arousal as well as potential perceptual and hedonic changes. These questions will be addressed in a later section.

Perceptual Deprivation

Numerous studies have examined the effects of increased stimulation on the organism. Unfortunately the effects of decreased stimulation have not received an equivalent amount of study. The majority of investigators that have looked at this area were concerned mainly with effects of prolonged perceptual deprivation. Nevertheless, a number of the studies have produced results of some relevance to exploratory behaviour.

Jones, Wilkinson and Braden (1961) used college students in a condition of visual deprivation produced by isolation in a lightproof chamber. The Ss were run

over a single 10 hour period. They had access to a selector dial which could cause patterns of light of varying complexity to appear. One group of Ss was allowed access to the dial after a delay of 1 hour, a second group after 5 hours. Their responses were shown to be a highly significant increasing monotonic function of the complexity of the light patterns. The 1-hr and 5-hr groups had different trends of responding over the hours.

Smith, Myers and Johnson (1968) tested groups of sensory deprived and control subjects on the need for stimulation at varying intervals after the start of the deprivation condition. Sensory deprivation consisted of isolation in a light and sound attenuated chamber. Control subjects were isolated in a chamber, however, they had access to television, music and reading material. They found that the deprived subjects chose to listen to a stock report to a significantly greater extent than the control group. This tendency increased as the length of the deprivation interval increased.

Jones and McGill (1967) compared the effects of sensory deprivation and satiation in two experiments. In the first, sensory deprived subjects were permitted to respond to series of tones differing in information value. They found that the response rate was a significantly increasing function of the information

value of the stimuli which was defined as the degree of randomness of tones in the tone series. In the second experiment subjects were exposed to auditory stimulation of maximum information value for either one or five hours. Following this the subjects were allowed to determine the information value of the auditory stimulation, but were not allowed to terminate the stimulation altogether. They found that the subjects chose to listen to auditory stimulation of less information content. This tendency was significantly greater for the five hour satiation group than for the one hour group.

Skrzypek (1967) compared psychopathic and neurotic delinquents who were subjected to 40 min of visual perceptual isolation, on their preferences for complexity. Both pre- and postmeasures of complexity preference were obtained. His results showed that after perceptual isolation both the psychopathic and the neurotic delinquents tended to increase their preference for more complex stimuli. The psychopathic subjects, in addition, increased their complexity preference scores significantly more than the neurotic subjects.

It is evident, therefore, that prolonged perceptual deprivation clearly results in an increased tendency to prefer stimulation with more information as well as more complex stimulation. However, the perceptual deprivation

conditions used were highly artificial and far from what the typical subject may encounter in his everyday environment. Thus, although the results of these experiments are important at least from a theoretical point of view, it is imperative that work employing more real-to-life conditions such as brief perceptual deprivation be done. A few investigators have in fact used brief perceptual deprivation although the number of studies is as yet quite small.

Leckart, Levine, Goscinski and Brayman (1970) showed that looking time could be influenced by brief periods of visual deprivation immediately before the viewing period. In their study, a direct relationship was obtained between duration of looking and deprivation intervals varying from 2 to 30 seconds. The researchers concluded that "short-term perceptual deprivation most likely produces a need for stimulation which is satisfied by viewing the stimulus for longer durations." In another study Leckart, Glanville, Hootstein, Keleman, and Yaremko (1972) investigated the perceptual deprivation effect as a function of stimulus complexity. They had college students view stimuli of low, middle, and high complexity. Visual deprivation (a dark room) periods of 2, 16, or 30 seconds, preceded each stimulus. Their results showed that looking time was a direct function of deprivation level and stimulus complexity and that the two variables

did not interact.

Berlyne and Crozier (1971) conducted an experiment in which ss had to choose between a response exposing a more complex visual pattern and a response exposing a less complex pattern, the two patterns being the same over a number of trials. The choice was preceded by 3.5 seconds of near darkness. They found that under these conditions the response exposing the more complex pattern was performed significantly more often, and this tendency became more marked over trials. Unfortunately they did not have a control group for comparison leaving the interpretation of their results uncertain.

A number of arguments within the parameters of optimal stimulation theory have been presented in an attempt to explain the effect of perceptual deprivation. Basically they can be divided into two types. One argument put forth by Berlyne (1963, 1967) hypothesized a U-shaped relationship between arousal and arousal potential. Thus, under conditions of perceptual deprivation where arousal potential is low he would maintain that arousal would increase from the optimal level. On the other hand, Fiske and Maddi (1961), Zuckerman (1969) among others, have argued that just the opposite occurs and arousal decreases from the optimal level because of a decrease in stimulation. On the surface it would appear that there should be no

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problem in determining which of the arguments is in fact correct. However, this has not been the case. Both hypotheses predict that looking time and preference for complexity - the most commonly used measure - would increase under perceptual deprivation. As a result we are still left with the task of differentiating between the two. This problem will be addressed in the later section.

Individual Differences

A number of theorists have argued that there are wide differences in optimal levels of stimulation among individuals. Zuckerman (1969) noted that some individuals seem to be more prone to seek out novel, complex or exciting situations than others. Brownfield (1972) and Schultz (1965) suggested that early environmental differences and possibly genetic factors may play an important role in determining optimal levels of stimulation in later life, possibly because these variables establish characteristic levels of cortical arousal. Eysenck (1967) also argued that individual differences in the need for stimulation exist. In his view extroverts and introverts require different amounts of stimulation to produce the same effects, due to differences in cortical excitatory/inhibitory potentials. As a result of this, in order to maintain a pleasant emotional state, extroverts tend to seek out stimulation

to a greater degree than introverts.

Zuckerman et al. (1964) developed the sensation seeking scale (SSS) in an attempt to assess individual differences in optimal levels of stimulation or arousal. They postulated that the need for change, variety, and intensity of stimulation would manifest itself in many aspects of behaviour, including sensory, social, and thrill-seeking types of activity. High sensation seekers, therefore, would be expected to prefer more complex stimulation than low sensation seekers. Some support for this hypothesis was obtained by Zuckerman et al. (1970). They administered the SSS and the Barron-Welsh Art Scale of the Welsh Figure Preference Test (Welsh, 1959) to their subjects and found that high sensation seekers tended to prefer more complex figures on the B-W Art Scale than low sensation seekers. In another study Zuckerman et al. (1972) attempted to develop a sensation seeking figure preference test using items from the Welsh Figure Preference Test which determined high and low sensation seekers. Although the investigators concluded that their results 'did not warrant the use of the Figure Preference Test as an alternative measure of sensation seeking they did find that the low sensation seekers liked simple, symmetrical, geometrical figures while the highs preferred complex, sketchy or shaded figures.'

According to Eysenck's model, cortical inhibitory potentials in extroverts are generated more rapidly and more intensely than excitatory potentials. As a result, extroverts require larger amounts of stimulation in order to achieve the same degree of cortical arousal as introverts. Therefore, in Eysenck's view there is, "a certain degree of stimulus hunger (sensation seeking, arousal seeking) in the extrovert, and a certain degree of stimulus aversion in the introvert." (1967, p. 110).

Farley and Farley (1967) investigated the association postulated by Eysenck (1967) between introversion-extroversion and sensation seeking. They administered the SSS and Eysenck's Personality Inventory (EPI) to 100 male subjects. Their results showed a significant positive correlation between the two tests. In another study Farley and Farley (1970) using British and American subjects again obtained significant correlations.

Osborne and Farley (1970) attempted to see if the relationship between preference and visual complexity with non artificial stimuli - abstract art - would hold. They also administered the extroversion scale of the EPI and the SSS to their subjects. Although their results showed that their subjects tended to prefer the more complex stimuli they failed to show any significant relationship between complexity preference and the two personality scales. However, as the authors themselves

admit this failure 'may have been an artifact of the restrictive sampling procedures used in the study' as well as of the relatively small number of subjects used.

In summary it may be said that the evidence seems to support the contention that personality variables as measured by the SSS and possibly the EPI play a significant role in preference for complexity at least with artificial stimuli. It still remains to be seen, however, if these differences extend to non artificial, more-real-to-life stimuli.

Summary

To recapitulate, evidence has been presented from numerous experiments with both animal and human subjects which supports the contention that stimulus complexity has a significant impact on exploratory behaviour. However, the nature of the relationship between preference and complexity, be it linear and increasing or inverted U-shaped, is still in doubt with many studies yielding contradictory results. The great variety of stimulus materials, the type of subjects and their motivational levels, the large differences in stimulus complexity from study to study probably account for the majority of the inconsistencies. In addition, it was argued that more work is needed with more-real-to-life stimuli before adequate generalizations can be made.

Further, it was shown that a number of factors including increased arousal, decreased stimulation and individual differences may play a significant role in determining the nature and direction of exploratory behaviour.

A number of problems were outlined and several questions which have never been adequately dealt with were raised. These questions and the hypotheses arising from them will be examined in the next section.

Plan of the Study and Hypotheses

Arousal

As previously mentioned a number of questions dealing with the timing and duration of arousal as well as potential perceptual and hedonic changes remain to be answered. Berlyne (1971) found white noise as prechoice stimulation to be no different from the silence condition. In fact more subjects in the white noise condition chose the more complex stimulus. On this basis he concluded that the distinguishing factor between the white noise condition and the recorded story condition was not arousal value but the level of exteroceptive information processing just before the choice. On the other hand Berlyne and Lewis (1963) using white noise as concurrent stimulation found just the opposite. Their subjects decreased the number of choices of high complex stimuli for longer inspection. One possible reason for the differences may be due to the possibility that Berlyne's level of ambient stimulation diminished the impact of the white noise. Another possibility may be that brief exposure to white noise leads to only momentary increases in arousal. If this is so, then the increased arousal may have quickly returned to its optimum level and had little influence on the selection of the stimuli for longer inspection. By

the same token, white noise presented concurrently with the visual stimulation should have a more pronounced effect on exploration since the shift in arousal takes place while the subject's attention is focused on the visual stimulation.

Another area which has not received adequate study deals with the direct effects of increased arousal on verbal ratings. Research has not focused on these questions and it is not clear whether or not responses remain stable as a function of extrinsically raised arousal.

In an attempt to answer these questions an experiment was conducted using three basic groups. In the first group, subjects experienced increased arousal via white noise prior to the exposure of each of the visual stimulus slides. In the second group, the subjects received the white noise concurrently with the visual art slides. A third group served as a control and did not receive any white noise.

In view of the possibility that some forms of exploration may be more affected by temporary changes in motivational state than others, a number of different measures of exploration were compared. The stimuli to be used consisted of 15 nonrepresentational art slides at three different levels of complexity. The measures of exploration included looking time and three verbal

ratings. In addition, a subjective rating of complexity was obtained. Thus, the three groups were divided such that half of each group was tested using looking time as a measure of exploration, while the other half was tested with the rating scales.

It was hypothesized that the increment in arousal resulting from the extrinsic use of white noise would lead to a decrease in looking time as a result of the subject's attempt to decrease the arousal potential of the stimulation. This decrease was expected to be more pronounced for high complex stimuli than for stimuli at low or medium complexity. Further, it was expected that concurrent stimulation would be a more effective condition leading to greater decrements in looking time.

With regard to the verbal ratings, no firm prediction could be made. However, it was expected that hedonic level would decrease with increases in arousal. This decrease was expected to be more pronounced at the higher complexity level than at the middle or low complexity level.

Perceptual Deprivation

Previous research suggests that under conditions of brief perceptual isolation increases in looking time as well as increases in preference for complexity are exhibited (Leckart et al. 1970, 1972; Berlyne & Crozier, 1971). The question that then arises is what factors

support these increases. Berlyne (1963, 1967) suggested that there is an increase in physiological arousal. Fiske and Maddi (1961), Zuckerman (1969) and others have argued that arousal decreases. If Berlyne's hypotheses and the predictions based on it are accepted it would mean that an individual in whom the arousal level is increased above the optimum level would come to prefer more complex stimuli. However, as was pointed out earlier, under conditions of increased cortical arousal preference for complexity decreases. One possible way to reconcile this discrepancy would be to assume that under the conditions of perceptual deprivation some type of perceptual modification takes place in which the perceived complexity of the more complex stimuli undergoes a downward shift i.e. it is perceived as less complex. Since Berlyne postulates an inverted-U function between preference and complexity, a perceptual shift from higher to lower perceived complexity would result in increased preference for the more complex stimuli. The prediction stemming from this would be that stimuli rated as high complex would undergo a downward shift in rated complexity.

The approach taken by Fiske and Maddi (1961) and Zuckerman (1969) seems to be more parsimonious. If arousal decreases from the optimum level as a result of decreased stimulation, then it would be expected that there would be a corresponding increase in looking time once the visual stimuli were exposed. The further the arousal level is away from the optimum level the longer

the looking times since it would take longer for the arousal potential of a given stimulus to be "used up". For the same reason more time would be spent looking at a stimulus of high complexity as compared to one of low complexity.

In addition there exists the possibility that the change may occur due to some perceptual modification as a result of which the subject may perceive the stimuli as being more complex and thus requiring more looking time. Another possibility is that perceived complexity does not in fact change. Rather there may be some change in the hedonic impact of the stimulus. A third possibility may include some interaction of the two variables.

In an attempt to clarify these issues an experiment was conducted to examine some of the variables involved. The measures of exploration included looking time and three verbal ratings. A subjective rating of complexity was also obtained. Three groups receiving varying amounts of brief visual perceptual deprivation were used.

It was expected that looking time would increase as a result of the deprivation conditions. Further, the longer the deprivation period, the greater the expected increase in looking time. With respect to the perceptual deprivation effect on the verbal ratings, it was expected that should any perceptual modification occur

it would be in the direction of increased judged complexity.

As well, should the change occur at the hedonic level,

it was expected to be in the direction of increased hedonic value. Again, the longer the deprivation, the more pronounced the changes.

Individual Differences

As mentioned earlier, Osborne and Farley (1970) failed to find any significant relationship between complexity preference and the SSS and EPI. Since there is a strong possibility that this was a function of their sampling procedure it was decided to test this in the present study using a larger and less restrictive sample.

As well Zuckerman et al. (1972) found that low sensation seekers liked simple, symmetrical, geometrical figures while the highs preferred complex, sketchy, or shaded figures. They hypothesized that the highs liked the more complex figures because of the figures' greater arousal potential. At the same time they suggested that the lows dislike them for the same reason.

This hypothesis was tested in the present study. It was expected that high sensation seekers would spend a greater proportion of their time fixating the high complex slides than the low sensation seekers. The inverse of this was expected for the low complex slides. With regard to rated hedonic value it was expected that

high sensation seekers would rate the high complex slides with greater hedonic value than the low complex stimuli. The inverse of this was expected for the low sensation seekers.

It was also expected that the SSS and the E scale of the EPI would correlate positively with each other as well as with looking time.

METHODOLOGY

EXPERIMENT I

Perceptual Deprivation

Subjects

Sixty male and female students from the introductory psychology class served as subjects for this experiment.

Apparatus

The subject was seated at a table in a light proof room approximately 114 cm away from a 28.5 x 31 cm rear-projection screen. The 15 stimulus slides (see Appendix A) were projected onto the screen from an adjacent room through a slot in the wall using a Kodak Ektagraphic 35 mm slide projector (Model AF-3). When projected on the screen the stimuli had 18.5 x 25 cm dimensions. In the looking time condition the subject had a microswitch in front of him which when depressed stopped a clock measuring looking time in the adjacent room and initiated the next trial. The experimenter had to record the time and reset the clock during the interval between stimulus slides. The entire presentation for both the looking time and the rating groups was automated using Bistable Foringer relays with LVE timers. In the rating scale condition each subject received a booklet containing the four rating scales for each of the stimulus slides

(Appendix B). In addition, each subject in every condition filled out the Sensation Seeking Scale and Eysenck's Personality Inventory.

Procedure

The subjects were divided into two basic groups, the rating group and the looking time group. Half of each group received 60 seconds of visual deprivation (darkness). The other half received 30 seconds of visual deprivation.

Rating group. The subject was seated in front of the screen on which the slides were to be projected and given the following written instructions.

"You are going to see a number of different slides of abstract art. Look at each slide and then fill out the four ratings scales. Once you have filled out the rating scales for a given slide do not go back and change it later, as I am interested in your first impressions. You will have 30 seconds per slide so work quickly."

The actual sequence was as follows: 60 sec. or 30 sec. of darkness followed by the first art slide for 30 sec. This sequence was repeated until all 15 slides were presented. The four scales consisted of subjective ratings of complexity, interestingness, pleasingness, and arousal.

Looking Time

The subjects received the following instructions:

"I am trying to determine if there are any similarities in the amounts of time different people spend looking at various works of art.

You are going to see a number of different slides of abstract art. Look at each slide for as long as you want. When you feel that you want to go on to the next slide, press and hold the switch in front of you until the slide is removed. There is no time limit so you may take all the time you want."

The actual sequence was as follows: 60 or 30 seconds of darkness followed by the first art slide. When the subject was ready for the next slide he pressed the microswitch in front of him. This stopped the clock in the adjacent room, and the next period of darkness began during which the time was recorded and the clock reset. The entire sequence was repeated until all 15 slides were presented. The 15 experimental trials were divided at random into three blocks of 5 trials each with the stipulation that all three complexity levels be represented in each of the blocks. In addition, half of the subjects in each group received the slides in one order while the other half received them in a reverse order. A 16th slide from the middle complexity range was used to start the series, however, it was not included in the statistical analysis since it was not preceded by any systematic deprivation period.

Control Group

The control group was also divided into a rating

group and looking time group, however, no visual deprivation was employed. The instructions to both groups were identical to those given under conditions of visual deprivation. The procedure was modified as follows: In the rating group the subject received the first slide for 30 seconds followed by a 30 second interstimulus interval during which no slides were presented. This interval was followed by the next slide. The sequence was repeated until all 15 slides had been presented. For the looking time group the procedure was identical to its deprivation counterpart except that instead of a period of darkness prior to each slide, a 30 sec interstimulus interval was used during which no art slide was presented.

All presentations were carried out with a 7½ watt lamp on in the subjects' cubicle.

Each subject in every group filled out the SSS and the EPI, one before the experiment began and the other after. The two tests were counterbalanced.

Design

The design of this experiment took the form of a 3 (deprivation levels) x 2 (order of slide) x 3 (complexity levels) factorial design with repeated measures on the last factor.

EXPERIMENT II

AROUSAL

Subjects

Another group of 60 students from the introductory psychology class served as subjects for this experiment.

Apparatus

The apparatus used in this experiment was identical to that used in the previous experiment. The white noise was recorded on a cassette tape and was delivered to the subject's cubicle through an auxiliary speaker. The intensity of the noise was set at 100 dB (S.P.L.) as measured by an H. H. Scott sound level meter (Type 412). The cassette player remained in the adjacent room with the experimenter.

Procedure

The subjects were divided into a rating group and a looking time group. Each of these were further subdivided into two preexposure and one concurrent group for a total of six groups. Each group under the rating as well as the looking time condition had to undergo an extrinsically induced increase in arousal. For this purpose a 5 sec burst of 100 dB (S.P.L.) white noise was used. The procedures for both the rating

and the looking time groups were nearly identical the only difference being that in the looking time group the subject controlled the exposure time of each slide while in the rating groups the time was controlled by the experimenter and set at 30 sec.

The actual sequence for the preexposure groups was as follows: 5 seconds of white noise followed 15 or 0 seconds later by the first art slide. The slide was followed by a 30 second interstimulus interval during which no white noise or art slides were presented. This sequence was repeated until all 15 slides had been presented. For the concurrent groups the white noise was presented during the first five seconds of each art slide presentation. The slide was followed by a 30 second interstimulus interval and then the sequence repeated itself for the next slide. Again, this continued until all 15 slides had been presented. All presentations were done automatically, as in the first experiment, with a $7\frac{1}{2}$ watt lamp on in the cubicle at all times.

As in the first experiment the slides were randomized in the same manner and half the subjects received them in one order and the other half received them in a reverse order. The same 16th slide was used to start the series as in experiment 1.

The instructions that the subjects received were identical to those in Experiment 1. In addition the

subjects were given the following information;

"Periodically you will hear a brief loud noise. It is not a signal for anything; rather it is being used because I am interested in the effects of loud noise on a person's performance."

The same group that served as a control in the first experiment was used as a control in the present experiment.

As in the first experiment each subject filled out the SSS and the EPI, one before the experiment began and the other after in a counterbalanced order.

Design

The design of this experiment took the form of a 4 (timing of arousal) x 2 (order of slides) x 3 (levels of complexity) factorial design with repeated measures on the last factor.

Summary of the Hypotheses

Perceptual Deprivation

1. It was expected that looking time would increase as a result of deprivation, with the Dep-60 condition resulting in the greatest increases..
2. Any rating shifts would be in the direction of increased judged complexity and increased pleasingness, with the greatest shifts occurring for the Dep-60 condition.

Arousal

3. The increment in arousal resulting from the use of white noise would lead to a decrease in looking time, with the greatest decreases expected for high complex stimuli.
4. It was expected that concurrent stimulation would be the most effective condition leading to greater decrements in looking time.
5. It was expected that pleasingness ratings would decrease with increases in arousal, the decrease being most pronounced for high complex stimuli.

Individual Differences

6. It was expected that high sensation seekers would spend a greater proportion of their time looking at the high complex slides than the low sensation seekers with the inverse of this expected for the low complex slides.

7. It was expected that high sensation seekers would rate the high complex slides with greater hedonic value than the low complex stimuli with the inverse of this expected for the low sensation seekers.

CHAPTER III

RESULTS

EXPERIMENT I

Looking Times

The looking time scores for each of the groups were tested for homogeneity of variance according to the Cochran test (Winer, 1971, p. 208). Significant departures from homogeneity of variance were found. The scores were then transformed to reciprocal values and tested again. None of the tests exceeded the .05 level of significance.

To test for possible intralevel variability between the stimulus slides a 3 x 5 analysis of variance with repeated measures on the last factor was performed for each of the three complexity levels (Winer, 1971, p. 518). The results are summarized in Table B in Appendix C. Since no intralevel significant differences were obtained between the stimulus slides, the data was collapsed and three scores - for low, medium and high complexity - were obtained for each subject.

A 3 x 2 x 3 analysis of variance with repeated measures on the last factor was performed on the data (Winer, 1971, p. 559). The sequence factor was not found to be significant and the groups were, therefore, pooled.

The mean scores for the control, 30 sec. deprivation (Dep-30) and 60 sec. deprivation (Dep-60) groups across complexity levels are summarized in Table 1.

TABLE 1
 MEAN RECIPROCAL LOOKING TIMES FOR LOW,
 MEDIUM AND HIGH COMPLEXITY

GROUPS	N	LOW		MEDIUM		HIGH	
		MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Control	10	.0731	.014	.0637	.021	.0518	.021
Dep-30	10	.0426	.014	.0339	.013	.0280	.011
Dep-60	10	.0381	.012	.0321	.013	.0256	.009

A 3 x 3 analysis of variance with repeated measures on one factor (Winer, 1971, p. 518) was performed on the pooled data. Table 2 presents a summary of this analysis. A significant deprivation effect, $F(2,27) = 15.44$, $p < .01$, and a significant complexity effect, $F(2,54) = 54.05$, $p < .001$ were obtained. There were no significant interaction effects.

Individual comparisons between groups at each level of complexity were performed using Dunnett's t-test. The results for the three complexity levels are presented in Table 3. For low complexity the Dep-30 and Dep-60 groups obtained significantly higher scores, $t(3,27) = -2.85$, $p < .05$; $t(3,27) = -3.27$, $p < .01$, respectively than the control group. No significant differences were observed between the Dep-30 and Dep-60 groups. For medium and high complexity levels the pattern of significant effects was the same with the Dep-30 and Dep-60 groups obtaining significantly higher scores, $t(3,27) = -2.79$, $p < .05$; $t(3,27) = -2.95$, $p < .05$, than the control group at the medium complexity level, and significantly higher scores, $t(3,27) = -2.22$, $p < .05$; $t(3,27) = -2.45$, $p < .05$, than the control group at the high complexity level. No significant differences were obtained between the Dep-30 and Dep-60 groups at the middle or high complexity levels.

TABLE 2
ANALYSIS OF VARIANCE OF EXPERIMENTAL AND CONTROL
GROUPS

SOURCE OF VARIATION	df	SS	MS	F
Between Subjects	29	.033		
Deprivation	2	.0176	.0088	15.44**
Error Between	27	.0154	.00057	
Within Subjects	60	.0061		
Complexity	2	.0040	.002	54.05***
D X C	4	.0001	.000025	.68
Error Within	54	.002	.000037	

** $p < .01$

*** $p < .001$

TABLE 3
DUNNETT'S t-TEST OF THE EXPERIMENTAL AND CONTROL
GROUPS FOR LOW, MEDIUM AND HIGH COMPLEXITY

GROUPS COMPARED	LOW		MEDIUM		HIGH	
	DIFFERENCE	t	DIFFERENCE	t	DIFFERENCE	t
Dep-30 - Control	-.0305	2.85**	-.0298	2.79**	-.0238	2.22*
Dep-60 - Control	-.0350	3.27***	-.0316	2.95**	-.0262	2.45**
Dep-60 - Dep-30	-.0045	0.42	-.0018	0.17	-.0024	0.22

* $p < .05$ (one tailed)
 ** $p < .05$ (two tailed)
 *** $p < .01$ (two tailed)

A trend analysis (Ferguson, 1976, p. 288) was performed for each complexity level using the looking time data from the three groups. The results are summarized in Table 4. Significant linear trends, $F(1,27) = 30.50$, $p < .001$; $F(1,27) = 19.23$, $p < .001$; $F(1,27) = 17.00$, $p < .001$, were obtained for low, medium and high complexity levels respectively. In addition, significant quadratic trends, $F(1,27) = 5.5$, $p < .05$; $F(1,27) = 5.0$, $p < .05$, were obtained for low and medium complexity levels. The quadratic trend for high complexity just failed to reach significance, $F(1,27) = 4.0$, $p > .05$. (See Figure 1).

Rating Scales

For each rating scale the 15 scores were collapsed such that three mean scores per scale - for low, medium and high complexity - were obtained for each subject.

A Kruskal-Wallis one way analysis of variance by ranks (Ferguson, 1976, p. 392) was performed for each complexity level comparing each of the scales across the three groups. Table 5 contains a summary of the H values obtained. For the complexity scale a significant shift towards greater rated complexity was obtained, but only at the high complex stimulus level, $H(2) = 6.13$, $p < .05$. For the pleasingness scale, on the other hand, significant upward shifts occurred at all three complexity levels, low $H(2) = 6.26$, $p < .05$; medium $H(2) = 7.06$,

TABLE 4
TREND ANALYSIS OF RECIPROCAL LOOKING TIMES
AS A FUNCTION OF VISUAL DEPRIVATION

SOURCE	df	LOW COMPLEXITY			MED COMPLEXITY			HIGH COMPLEXITY		
		SS	MS	F	SS	MS	F	SS	MS	F
LINEAR	1	.0061	.0061	30.5***	.005	.005	19.23***	.0034	.0034	17.00***
QUADRATIC	1	.0011	.0011	5.5*	.0013	.0013	5.00	.0008	.0008	4.00
DEVIATION	0									
WITHIN	27	.0047	.0002		.0071	.00026		.0057	.0002	

*** $p < .001$
* $p < .05$

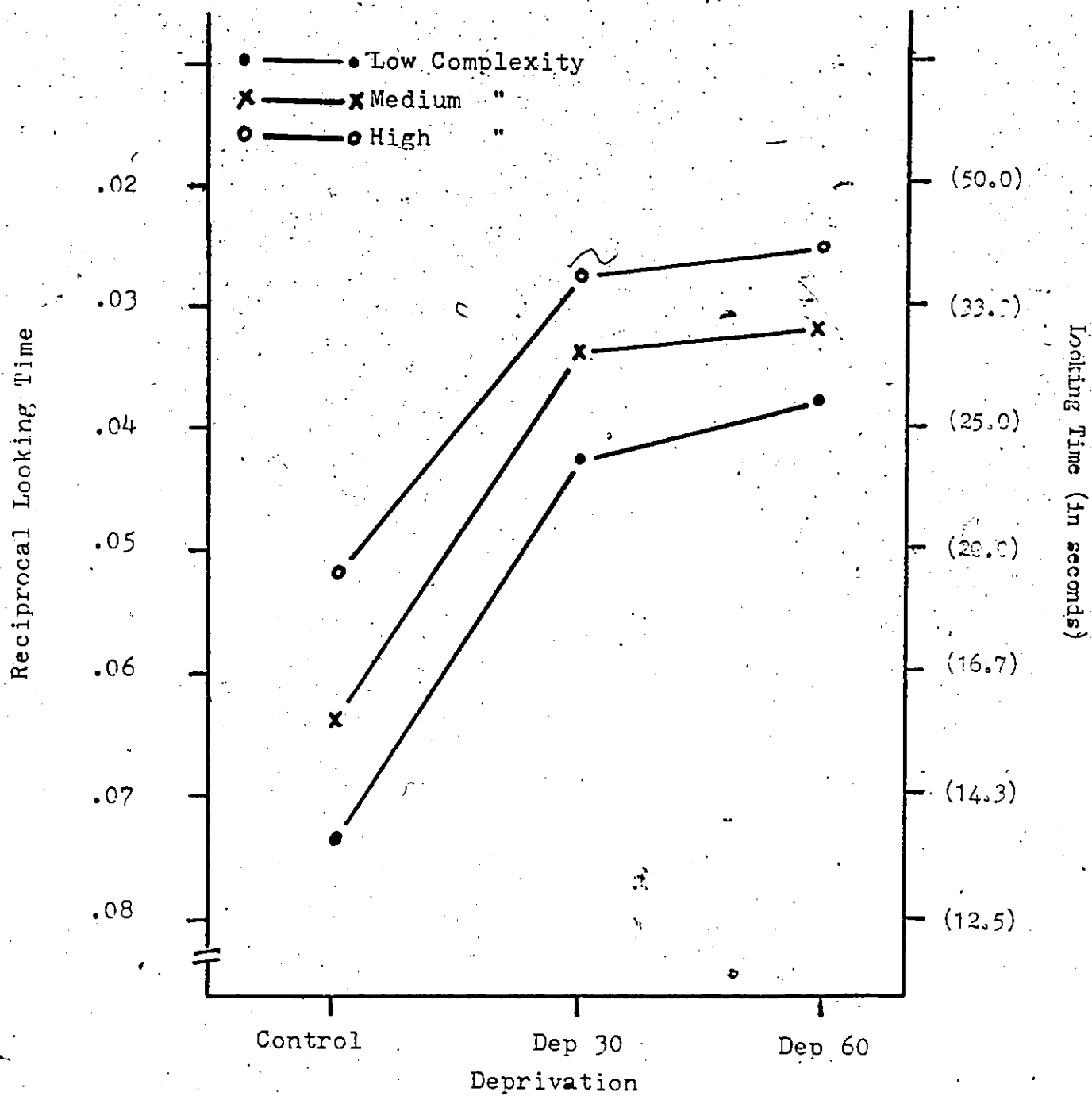


Fig. 1 Looking time as a function of Deprivation and Complexity

TABLE 5
 KRUSKAL-WALLIS ANALYSIS OF VARIANCE
 FOF SHIFTS IN RATINGS

RATING SCALES	COMPLEXITY		
	LOW	MEDIUM	HIGH
COMPLEXITY	1.47	1.25	6.13*†
PLEASINGNESS	6.26*†	7.06*†	6.42*†
INTERESTINGNESS	1.63	0.89	1.08
AROUSAL	1.90	3.04	6.21*†

* $p < .05$

† upward shift

$p < .05$; high $H(2) = 6.42$, $p < .05$. No significant shifts were noted for the interestingness scale at any of the three complexity levels. For the arousal scale a significant upward shift, $H(2) = 6.21$, $p < .05$, was obtained for the high complexity level. (See Figures 2-5).

A multiple comparison rank sum test (Steel, 1959) was applied to the data demonstrating significant shifts through the Kruskal-Wallis analysis of variance. A summary of these results may be seen in Table 6. None of the differences between the control group and the Dep-30 group were found to be significant. The differences between the control and the Dep-60 group were significant for the complexity ratings at the high complex level, min (134.5, 75.5), $p < .05$; for the pleasingness ratings at the low, min (134.5, 75.5), $p < .05$; medium, min (135, 75), $p < .05$; and high, min (134.5, 75.5), $p < .05$, complex levels; and at the high complex level for the arousal rating scale, min (133.5, 76.5) $p < .05$.

Looking time vs. Rating Scales

Pearson product-moment correlation coefficients were computed between reciprocal looking time and the four rating scales for the control, Dep-30 and Dep-60 groups. The results are summarized in Table 7. For the control group significant correlations were found, $r = -.92$, $p < .01$;

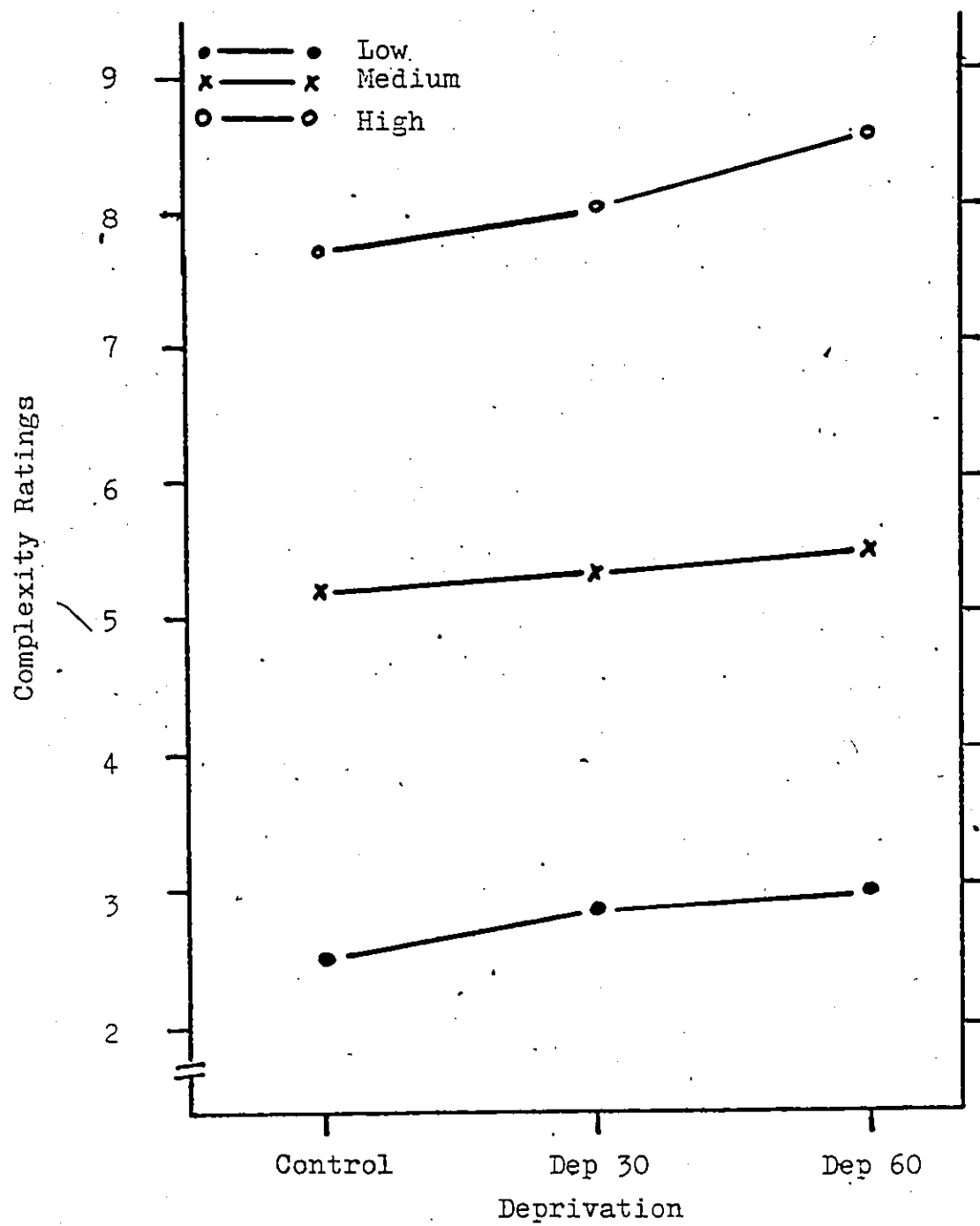


Fig. 2 Complexity Ratings as a function of Deprivation

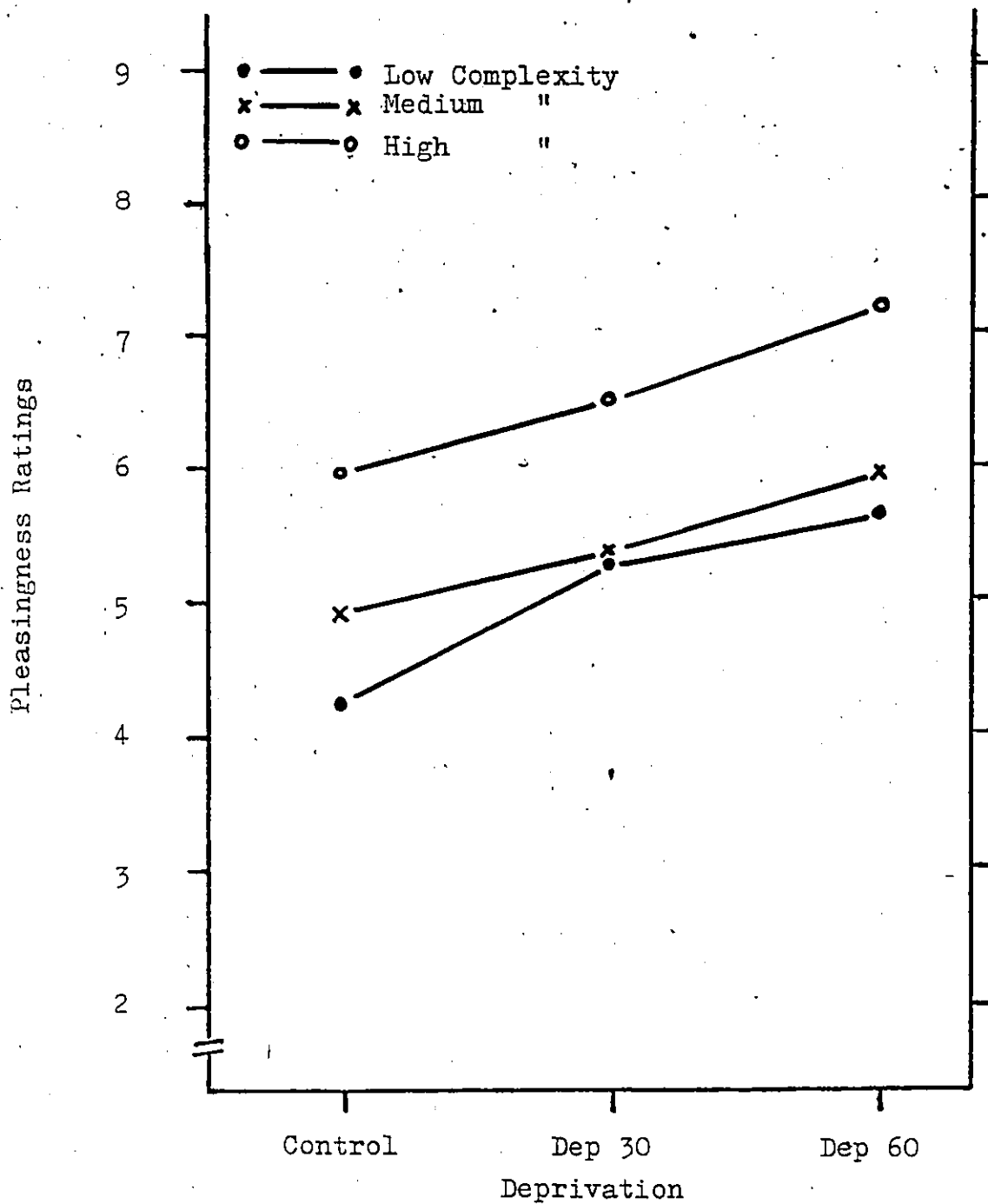


Fig. 3 Pleasingness as a function of Deprivation

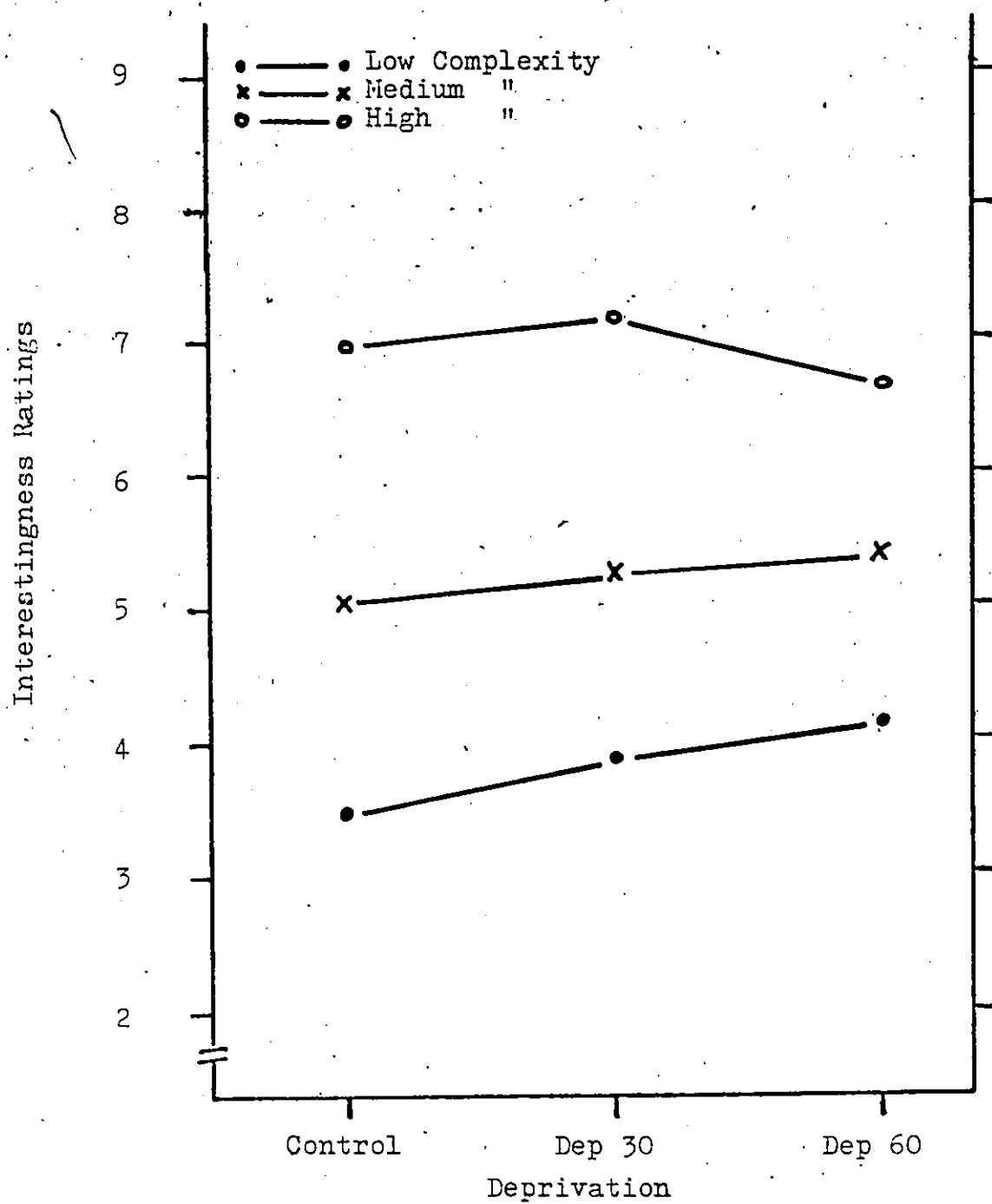


Fig. 4 Interestingness as a function of Deprivation

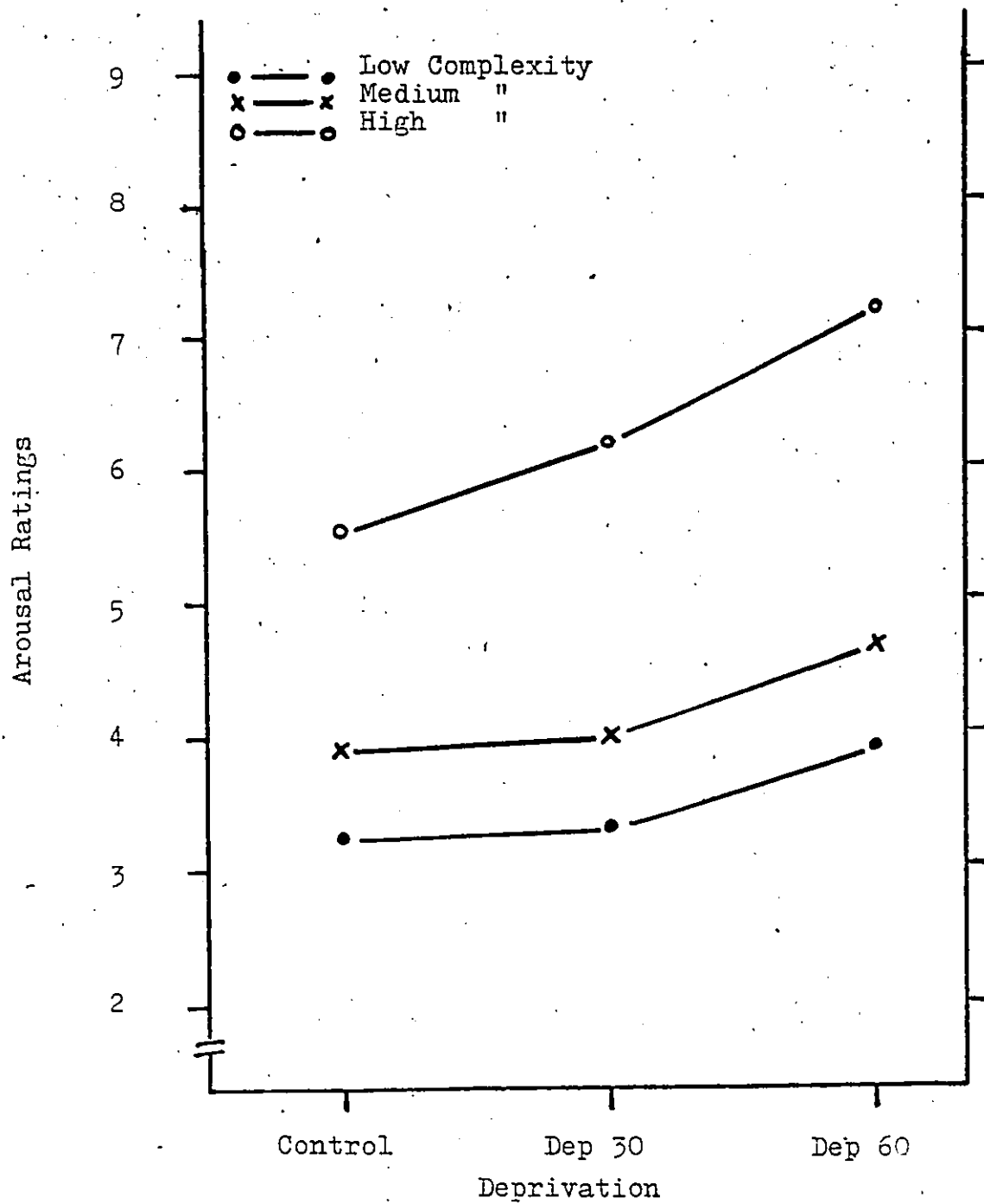


Fig. 5 Arousal as a function of Deprivation

TABLE 6

MULTIPLE COMPARISON RANK SUM TEST FOR

CONTROL AND EXPERIMENTAL GROUPS

RATING SCALES	CONTROL vs. DEP-30			CONTROL vs. DEP-60		
	LOW	MED	HIGH	LOW	MED	HIGH
COMPLEXITY	-	-	m(118.5, 91.5)	-	-	m(134.5, 75.5)**
PLEASINGNESS	m(127, 83)	m(120, 90)	m(120, 90)	m(134.5, 75.5)**	m(135, 75)**	m(134.5, 75.5)**
AROUSAL	-	-	m(121.5, 88.5)	-	-	m(133.5, 76.5)*

* $p < .05$ (one sided)** $p < .05$ (two sided)

TABLE 7
CORRELATIONS BETWEEN RECIPROCAL LOOKING TIME
AND RATING SCALES

GROUP	N	COMPLEXITY	INTEREST.	PLEASING.	AROUSAL
CONTROL	10	-.92**	-.90**	-.70*	-.76*
DEP-30	10	-.97**	-.42	-.85**	-.76*
DEP-60	10	-.80**	-.70*	-.52	-.62

* $p < .05$

** $p < .01$

$r = -.90, p < .01$; $r = -.70, p < .05$; $r = -.76, p < .05$, for ratings of complexity, interestingness, pleasingness and arousal respectively. For the Dep-30 group significant correlations were found, $r = -.97, p < .01$; $r = -.85, p < .01$; $r = -.76, p < .05$, for ratings of complexity, pleasingness and arousal respectively.

For the Dep-60 group significant correlations were found, $r = -.80, p < .05$; $r = -.70, p < .05$, for ratings of complexity and interestingness respectively. (The negative r 's occur as a result of the use of reciprocal looking times. The relationships are in fact positive).

EXPERIMENT II.

Looking Times

As in Experiment I, significant departures from homogeneity of variance were found for the looking time scores. The scores were then transformed to reciprocal values and tested again according to the Cochran test (Winer, 1971, p. 208). None of the tests exceeded the .05 level of significance.

To test for possible intralevel variability between the stimulus slides a 3 x 5 analysis of variance with repeated measures on the last factor was performed for each of the three complexity levels (Winer, 1971, p. 518). The results are summarized in Table C in Appendix C. Since no intralevel significant differences were obtained between the stimulus slides, the data was collapsed and three scores - for low, medium and high complexity - were obtained for each subject.

A 4 x 2 x 3 analysis of variance with repeated measures on the last factor was performed on the data (Winer, 1971, p. 559). The sequence factor was not found to be significant and the groups were, therefore, pooled.

The mean scores for the control, Pre "15", Pre "0" and Concurrent groups across complexity levels are summarized in Table 8.

TABLE 8
 MEAN RECIPROCAL LOOKING TIMES FOR
 LOW, MEDIUM AND HIGH COMPLEXITY

GROUPS	N	LOW		MEDIUM		HIGH	
		MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
CONTROL	10	.0731	.014	.0637	.021	.0518	.021
PRE "15"	10	.0947	.029	.0823	.052	.0596	.030
PRE "0"	10	.1222	.044	.0813	.031	.0693	.027
CONCURRENT	10	.1371	.046	.1020	.032	.0831	.015

A 4 x 3 analysis of variance with repeated measures on one factor (Winer, 1971, p. 518) was performed on the pooled data. Table 9 presents a summary of this analysis. A significant arousal effect, $F(3,36) = 5.37$, $p < .01$, and significant complexity effects, $F(2,72) = 29.65$, $p < .001$ were obtained. There were no significant interaction effects.

Individual comparisons between groups at each level of complexity were performed using Dunnett's t-test. The results for the three complexity levels are presented in Table 10. For low complexity the Pre "0" and the concurrent arousal groups obtained significantly lower scores, $t(4,36) = 2.47$, $p < .05$; $t(4,36) = 3.22$, $p < .01$, than the control group. The concurrent arousal group obtained a significantly lower score, $t(4,36) = -2.13$, $p < .05$, than the Pre "15" arousal group. No other significant differences were observed. No significant differences were observed for the medium or for the high complex groups.

A trend analysis (Ferguson, 1976, p. 288) was performed for each complexity level using data from the three experimental groups. Since the intervals used in the three groups were unequal, orthogonal coefficients for unequal intervals were first constructed (Grandage, 1958). The results of the trend analyses are summarized in Table 11. Significant linear trends, $F(1,27) = 5.69$,

TABLE 9
ANALYSIS OF VARIANCE OF EXPERIMENTAL AND
CONTROL GROUPS

SOURCE OF VARIATION	df	SS	MS	F
BETWEEN SUBJECTS	39	.10308		
AROUSAL	3	.03193	.01064	5.37**
ERROR BETWEEN	36	.07115	.00198	
WITHIN SUBJECTS	80	.08015		
COMPLEXITY	2	.03377	.0169	29.65***
A X C	6	.00526	.00088	1.54
ERROR WITHIN	72	.04112	.00057	

** $p < .01$
*** $p < .001$

TABLE 10

DUNNETT'S t-TEST OF THE EXPERIMENTAL AND CONTROL
GROUPS FOR LOW, MEDIUM AND HIGH COMPLEXITY

GROUPS COMPARED	LOW DIFFERENCE	t	MEDIUM DIFFERENCE	t	HIGH DIFFERENCE	t
PRE "15"-CONTROL	.0216	1.09	.0186	.94	.0078	.39
PRE "0"-CONTROL	.0491	2.47**	.0176	.89	.0175	.88
CONCUR.-CONTROL	.064	3.22***	.0383	1.93	.0313	1.57
PRE "15"-PRE "0"	-.0275	1.38	.001	.05	-.0097	.49
PRE "15"-CONCUR.	-.0424	2.13*	-.0197	.99	-.0235	1.18
PRE "0"-CONCUR.	-.0149	.75	-.0207	1.04	-.0138	.69

* $p < .05$ (one tailed)** $p < .05$ (two tailed)*** $p < .01$ (two tailed)

TABLE 11
TREND ANALYSIS OF RECIPROCAL LOOKING TIMES
AS A FUNCTION OF AROUSAL

SOURCE	df	LOW COMPLEXITY			MED COMPLEXITY			HIGH COMPLEXITY		
		SS	MS	F	SS	MS	F	SS	MS	F
LINEAR	1	.0091	.0091	5.69*	.0012	.0012	1.2	.0025	.0025	4.24*
QUADRATIC	1	.00011	.00011	.07	.0015	.0015	1.5	.0004	.0004	.68
DEVIATION	0									
WITHIN	27	.0442	.0016		.031	.001		.016	.00059	

* $p < .05$

$p < .05$; $F(1,27) = 4.24$, $p < .05$, were obtained for low and high complexity levels respectively. No significant trends were observed for the mid complexity level.

(See Figure 6).

Rating Scales

As in Experiment I, the 15 scores for each rating scale were collapsed and three mean scores per scale - for low, medium and high complexity - were obtained for each subject.

A Kruskal-Wallis one way analysis of variance by ranks (Ferguson, 1976, p. 392) was performed for each of the rating scales comparing them across all four groups. As previously, the analysis was performed for each complexity level. Table 12 contains a summary of the H values obtained. For the complexity scale a significant shift towards greater rated complexity was obtained at the high complex stimulus level, $H(3) = 7.93$, $p < .05$. For the pleasingness scale, on the other hand, significant downward shifts (ie. reductions in hedonic values) occurred at the medium, $H(3) = 11.65$, $p < .01$, and high, $H(3) = 8.39$, $p < .05$, complexity levels. The ratings' shift at the low complexity level was also downward but just failed to reach significant proportions, $H(3) = 7.64$, $p > .05$. No significant shifts were noted for the interestingness scale at any of the three complexity levels. For the arousal scale, significant upward shifts

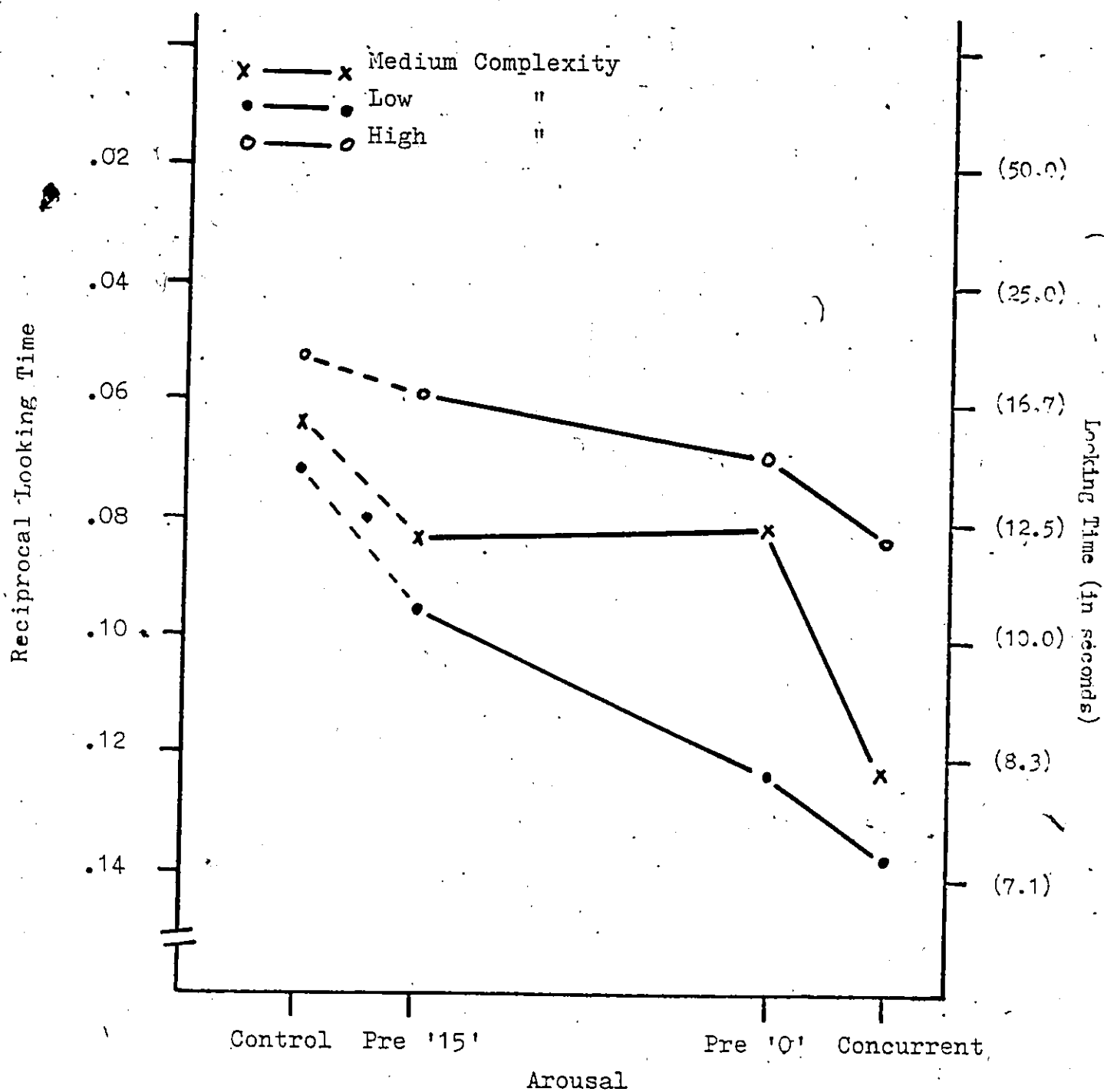


Fig. 6 Looking time as a function of Arousal and Complexity

TABLE 12
 KRUSKAL-WALLIS ANALYSIS OF VARIANCE
 FOR SHIFTS IN RATINGS

RATING SCALES	LOW	COMPLEXITY MEDIUM	HIGH
COMPLEXITY	.67	2.48	7.93*†
PLEASINGNESS	7.64	11.65**†	8.39*†
INTERESTINGNESS	4.23	1.76	1.58
AROUSAL	4.95	8.60*†	8.21*†

* $P < .05$

** $P < .01$

† upward shift

† downward shift

(ie. increased arousal value) were noted for medium, $H(3) = 8.60$, $p < .05$, and for high, $H(3) = 8.21$, $p < .05$, complexity levels. (See Figures 7-10).

A multiple comparison rank sum test (Steel, 1959) was applied to the data demonstrating significant shifts in the Kruskal-Wallis analysis of variance. A summary of these results may be seen in Tables 13a and 13b. None of the differences between the control group ratings and the Pre "15" arousal group ratings proved to be significant. Significant differences were found between the control group ratings and the Pre "0" arousal group ratings but only for the pleasingness scale at the medium, min (137, 73) $p < .05$, and high, min (135.5, 74.5) $p < .05$, complexity levels (Table 13a). In comparisons between the control and the concurrent arousal groups, significant differences were found for the complexity scale but only at the high complexity level, min (137.5, 72.5), $p < .05$. Significant differences were also found for the pleasingness scale at the low, min (138.5, 71.5) $p < .05$; medium, min (141.5, 68.5), $p < .05$; and high, min (138.5, 71.5), $p < .05$, complexity levels. Differences for the arousal scale also proved significant at the medium, min (138.5, 71.5), $p < .05$, and high, min (136, 74), $p < .05$, complexity levels (Table 13b).

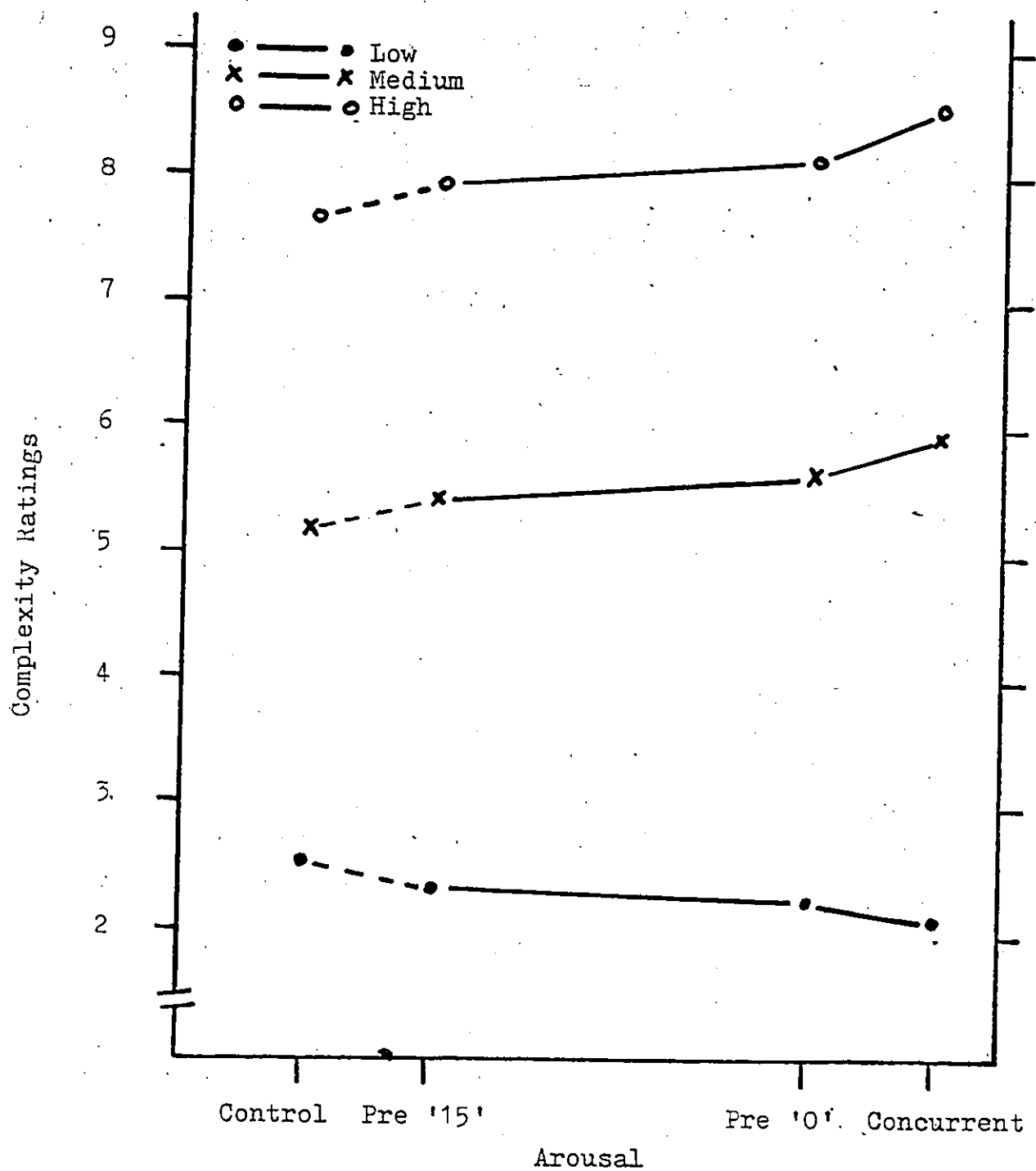


Fig. 7 Complexity ratings as a function of Arousal

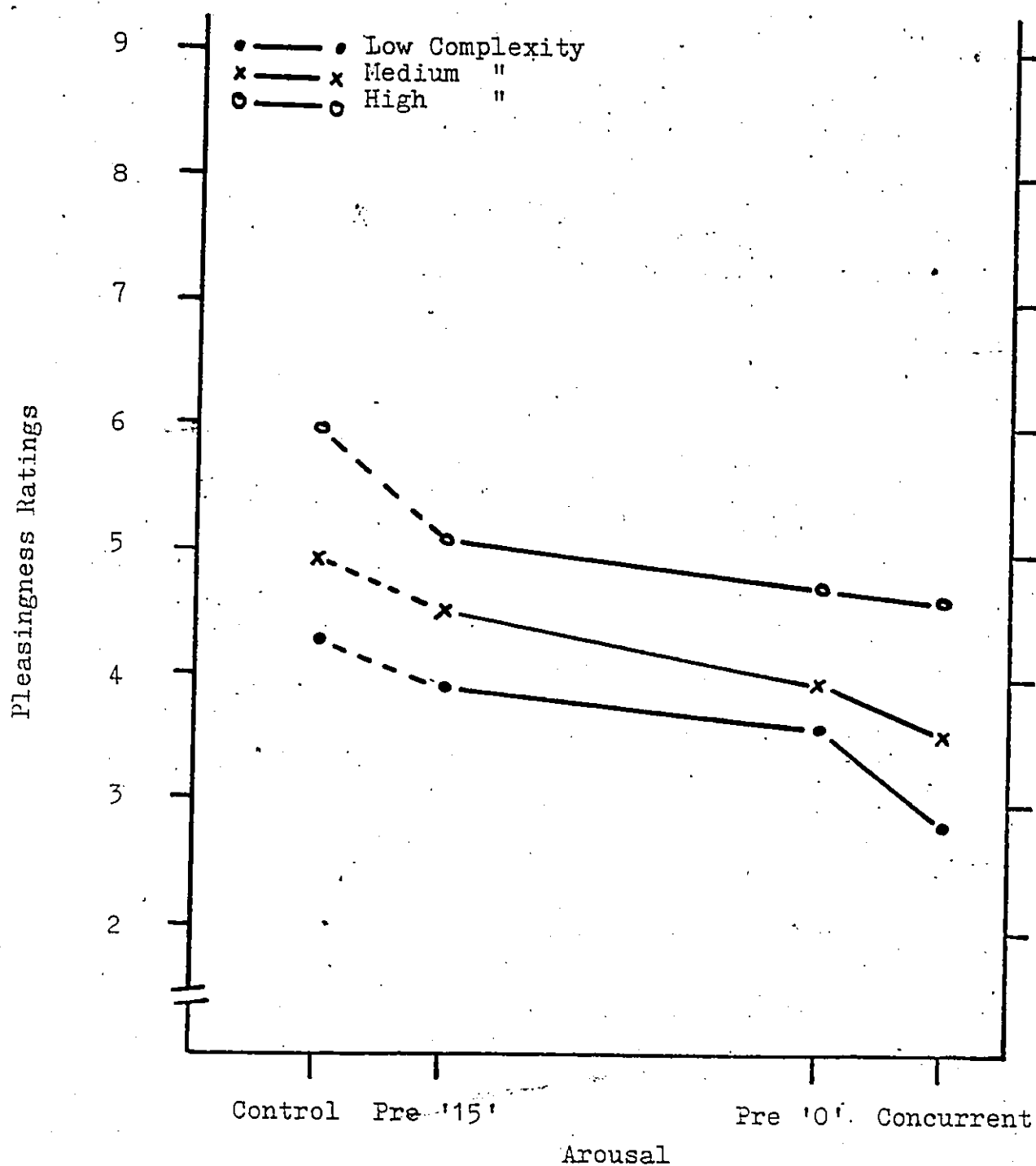


Fig. 8 Pleasingness as a function of Arousal

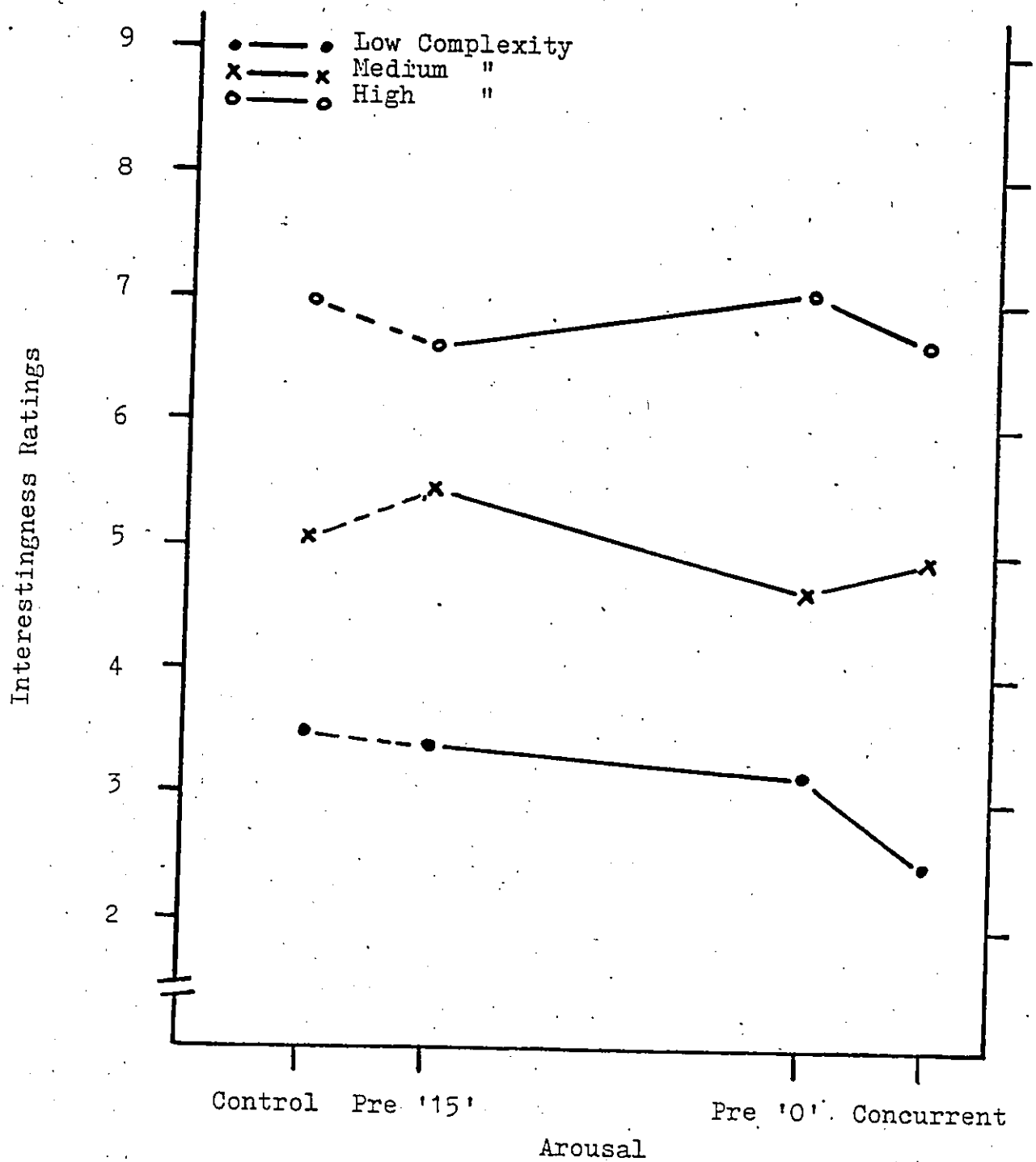


Fig. 9 Interestingness as a function of Arousal

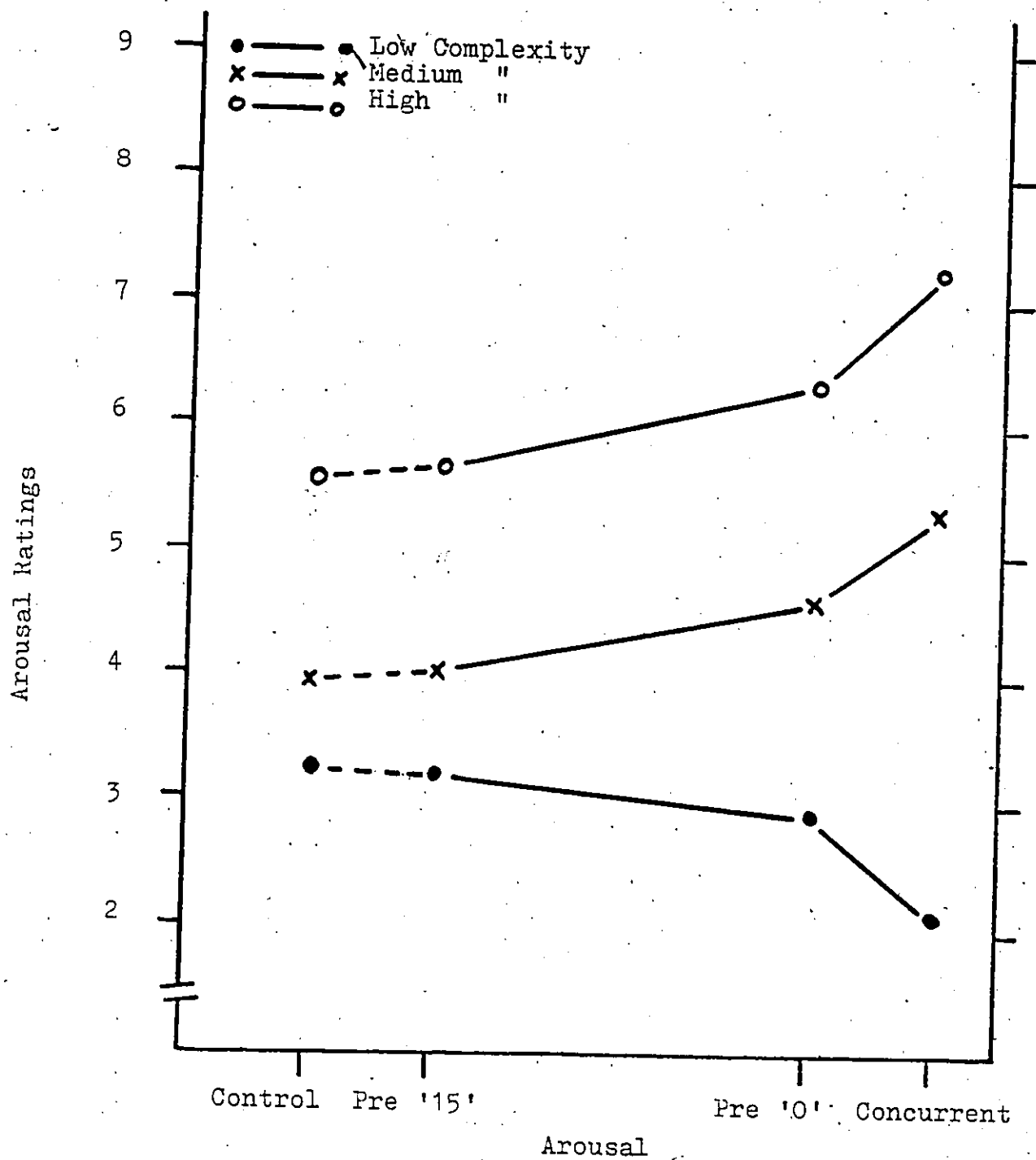


Fig. 10 Arousal ratings as a function of Arousal

TABLE 13a
MULTIPLE COMPARISON RANK SUM TEST FOR
CONTROL AND EXPERIMENTAL GROUPS

RATING SCALES	CONTROL vs. PRE "15"			CONTROL vs. PRE "0"		
	LOW	MED	HIGH	LOW	MED	HIGH
COMPLEX.	-	-	m(110.5, 99.5)	-	-	m(123.5, 86.5)
PLEASING.	m(113, 97)	m(118.5, 91.5)	m(128, 82)	m(122.5, 88.5)	m(137, 73) **	m(135, 5, 74.5) *
AROUSAL	-	m(109, 101)	m(112, 98)	-	m(123.5, 86.5)	m(122, 88)

* $p < .05$ (one tailed)

** $p < .05$ (two tailed)

TABLE 13b
MULTIPLE COMPARISON RANK SUM TEST FOR
CONTROL AND EXPERIMENTAL GROUPS

α

RATING SCALES	CONTROL vs. CONCURRENT		
	LOW	MED	HIGH
COMPLEX	-	-	m(137.5, 72.5)**
PLEASING.	m(138.5, 71.5)**	m(141.5, 68.5)**	m(138.5, 71.5)**
AROUSAL	m(128, 82)	m(138.5, 71.5)**	m(136, 74)*

* $p < .05$ (one tailed)

** $p < .05$ (two tailed)

Looking time vs. Rating Scales

Pearson product-moment correlation coefficients were computed between reciprocal looking time and the four rating scales for the Control, Pre "15", Pre "0" and Concurrent arousal groups. The results are summarized in Table 14. (The negative r 's occur, as in Experiment I, as a result of the use of reciprocal looking times. The relationships are in fact positive).

TABLE 14
CORRELATIONS BETWEEN RECIPROCAL LOOKING TIME
AND RATING SCALES

GROUP	N	COMPLEXITY	INTEREST.	PLEASING.	AROUSAL
CONTROL	10	-.92**	-.90**	-.70*	-.76*
PRE "15"	10	-.85**	-.88**	-.72*	-.84**
PRE "0"	10	-.86**	-.78*	-.60*	-.85**
CONCURRENT	10	-.96**	-.93**	-.93**	-.94**

* $P < .05$

** $P < .01$

PERSONALITY VARIABLES

Looking Times

The raw looking time scores for each subject from Experiments I and II were converted to percentages of total looking time. Since measurement scales in terms of percentage generally do not provide homogeneity of variance (Winer, 1971, p. 537), an arcsine transformation was performed on the percentages. The transformed data were tested for homogeneity of variance according to the Cochran test (Winer, 1971, p. 208). None of the tests exceeded the .05 level of significance. For each subject scores for low, medium and high complexity were obtained. To determine if there were significant differences between the groups with respect to the proportion of looking times at each level of complexity a 6×3 analysis of variance with repeated measures on the last factor (Winer, 1971, p. 518) was performed on the transformed data. Table D in Appendix D contains a summary of the analysis. No significant differences in the proportions of looking times were obtained, $F(5,54) = 1.18, p > .05$.

Pearson product - moment correlation coefficients were computed between % looking time and the Sensation Seeking Scale (Form V) as well as the Extraversion Scale of the Eysenck Personality Inventory. Table 15 presents a summary of this analysis. For low and medium complexity³ none of the correlations between % looking time and the

TABLE 15

CORRELATIONS BETWEEN % LOOKING TIME, SENSATION SEEKING

SUBSCALES AND EYSENCK'S EXTRAVERSION SCALE FOR LOW,

MEDIUM AND HIGH COMPLEXITY

PERSONALITY SCALES	N	LOW	COMPLEXITY MEDIUM	HIGH
THRILL AND ADV. SEEKING (TAS)	60	-.14	.04	.13
EXPERIENCE SEEKING (ES)	60	-.14	-.05	.22*
DISINHIBITION (DIS)	60	-.12	-.03	.14
BOREDOM SUSCEPTIBILITY (BS)	60	-.09	-.11	.18
TOTAL	60	-.17	-.04	.26**
EXTRAVERSION SCALE (E)	60	.06	-.13	.04

* $p < .05$ (one tailed)** $p < .05$ (two tailed)

sub scales of the SSS proved to be significant. The correlation between % looking time and the Extraversion Scale was similarly nonsignificant. For high complexity the correlations between % looking time and the ES scale $r = .22$, $p < .05$, as well as the Total scale, $r = .26$, $p < .05$, proved to be significant. None of the other correlations were significant.

To compare high and low sensation seekers in terms of their looking times, three groups of 10 subjects each were selected at random from the subjects of Experiments I and II; one comprised of subjects obtaining scores in the top 20 percentiles on the SSS; a second group with scores in the 40-60 percentile range and a third group with scores in the bottom 20 percentile range (Zuckerman, 1978). A 3×3 analysis of variance with repeated measures on the last factor was performed using the arcsine transformations as the criterion scores. A summary of the results is available in Table 16. In the analysis no significant differences were found between the looking times of high and low sensation seekers, $F(2,27) = .70$, $p > .05$. The complexity factor, however, proved to be highly significant, $F(2,54) = 40.59$, $p < .001$. There was no significant interaction between the two factors, $F(4,54) = 2.42$, $p > .05$.

A trend analysis was performed for each complexity level to test for the presence of any trends as a function

TABLE 16

ANALYSIS OF VARIANCE OF THE ARCSINE TRANSFORMATIONS
OF LOOKING TIMES AS A FUNCTION OF LOW, MEDIUM
AND HIGH SENSATION SEEKING (TOTAL)

SOURCE OF VARIATION	df	SS	MS	F
BETWEEN SUBJECTS	29	.00369		
SENSATION SEEKING	2	.00018	.0000905	.70
ERROR BETWEEN	27	.00351	.00013	
WITHIN SUBJECTS	60	3.289		
COMPLEXITY	2	1.843	.9215	40.59***
S X C	4	.220	.055	2.42
ERROR WITHIN	54	1.226	.0227	

*** $p < .001$

of sensation seeking. A summary of the results is presented in Table 17. For low complexity a significantly decreasing linear trend was obtained, $F(1,27) = 4.55$, $p < .05$. For medium complexity no significant trends were observed. For high complexity a significantly increasing linear trend was obtained, $F(1,27) = 6.52$, $p < .05$. (See Figure 11).

Rating Scales

To determine if high and low sensation seekers rated the slides differentially with respect to hedonic values, two groups of subjects representing high and low sensation seekers were selected from the subjects in Experiments I and II. Unfortunately, due to an insufficient number of subjects at the two extremes of the sensation seeking scale the range for selection had to be expanded to the upper 30 and lower 30 percentiles on the SS scale. Table 18 shows the mean hedonic ratings for each group. Wilcoxon matched pairs signed ranks tests (Ferguson, 1976, p. 390) were performed on the available data for low and high sensation seekers to compare their hedonic ratings for stimuli of low and high complexity. The results showed that the high complex stimuli were found to be significantly more pleasing, $W_+ = 18.5$, $p < .05$; $W_+ = 9.0$, $p < .001$, than the low complex stimuli for both, low and high sensation seekers respectively. These results must, however, be

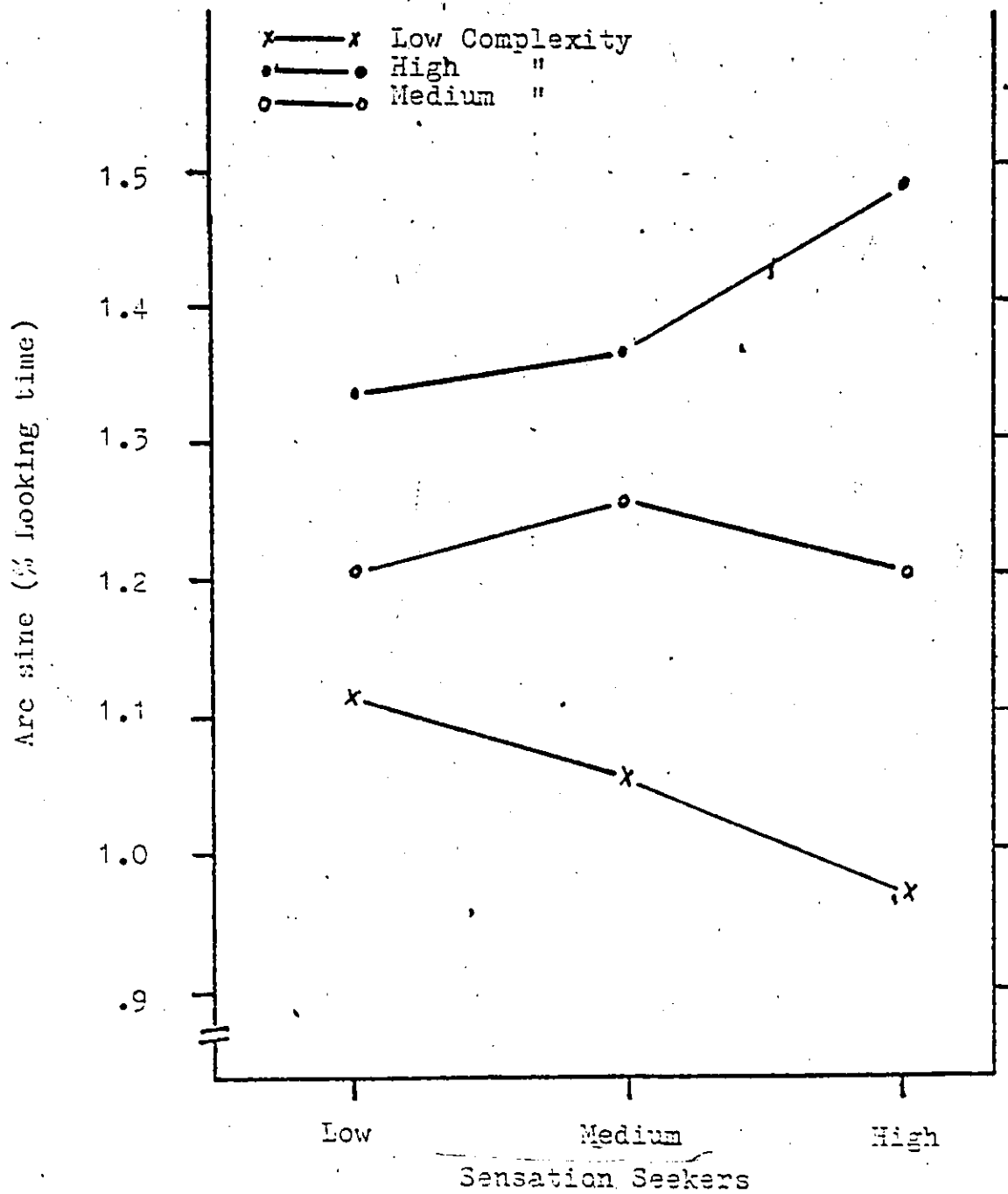


Fig. 11 % Looking time spent on Low, Medium and High complex stimuli as a function of Sensation Seeking

TABLE 17
TREND ANALYSIS OF LOOKING TIMES AS A FUNCTION
OF SENSATION SEEKING FOR LOW, MEDIUM AND
HIGH COMPLEXITY

SOURCE	df	LOW COMPLEXITY			MED COMPLEXITY			HIGH COMPLEXITY		
		SS	MS	F	SS	MS	F	SS	MS	F
LINEAR	1	.091	.091	4.55*	.00108	.00108	.11	.0997	.0997	6.52*
QUADRATIC	1	.000	.000	0.00	.0156	.0156	1.61	.0127	.0127	.83
DEVIATION	0									
WITHIN	27	.55	.02		.263	.0097		.413	.0153	

* $p < .05$

TABLE 18

MEAN HEDONIC RATINGS FOR LOW AND HIGH SENSATION

SEEKERS

GROUPS	N	LOW SSS			HIGH SSS		
		LOW MEAN	LOW COMP. S.D.	HIGH MEAN	LOW MEAN	HIGH COMP. S.D.	HIGH MEAN
CONTROL	3	3.6	1.4	5.4	3.93	.95	6.87
DEP-30	1	-	-	-	5.10	.97	6.70
DEP-60	0	-	-	-	5.70	1.56	7.70
PRE "15"	4	4.3	1.54	5.2	3.40	.85	5.50
PRE "0"	4	3.35	1.51	3.85	2.70	.42	5.30
CONCURRENT	4	2.20	.37	4.75	4.07	.95	3.80

interpreted with caution due to the range used, the small N and the absence of low sensation seekers from the Dep-30 and Dep-60 groups.

Sensation Seeking and Extraversion

Pearson product - moment correlation coefficients were computed between the Sensation Seeking subscales and the Extraversion Scale. The results are summarized in Table 19. All of the correlations, with the exception of the ES and Extraversion Scale correlation for male subjects, were found to be significant at least at the $p < .05$ level.

TABLE 19
CORRELATIONS BETWEEN SSS SUBSCALES AND EXTRAVERSION
SCALE FOR MALES, FEMALES AND TOTAL SAMPLE

SUBJECTS	N	TAS	ES	DYS	BS	TOTAL
MALE	32 (E-SCALE)	.35*	.33	.47**	.49**	.55**
FEMALE	88 (E-SCALE)	.31**	.29**	.33**	.37**	.47***
TOTAL	120 (E-SCALE)	.32***	.30***	.37***	.41***	.48***

* $p < .05$

** $p < .01$

*** $p < .001$

CHAPTER IV

DISCUSSION

Perceptual Deprivation

It was found that looking times increased for all three complexity levels following the administration of periods of visual deprivation. These results provide support for the first part of hypothesis (1) and are in line with the findings of other researchers who found that under conditions of brief visual deprivation subjects increase their preference for complexity in choice situations, Berlyne & Crozier (1971), and increase their looking times for stimuli of all complexity levels without any interaction between the two variables; Leckart et al (1970); Leckart et al (1972).

Some support was found for the second part of hypothesis (1). The scores for the Dep-60 group were higher at all three complexity levels and the linear trends were found to be significant. The presence of quadratic trends suggests that even though the period of deprivation was extended, the deprivation effect appeared to be decelerating (See Fig. 1). This was evident at all three complexity levels although the trend for high complex stimuli just failed to reach significance. Previous studies examining the brief perceptual deprivation effect showed no evidence of

any quadratic trends. However, the deprivation periods employed in those studies were generally 30 seconds or less. Thus if the quadratic trend is not an artifact of the current experiment then it appears possible that as the deprivation period is extended beyond approximately 30 seconds deceleration in arousal decrement may occur with a concomitant deceleration in the increase in looking time. This hypothesis may be tested in subsequent experiments employing increasingly greater periods of deprivation with the same set of stimuli to permit direct comparisons.

An examination of the results for the rating scales revealed an increase in judged complexity at all complexity levels as a function of deprivation, although only the increases for the high complex level proved significant. This provides some support for hypothesis (2) and suggests that a shift towards greater perceived complexity may have occurred. Previous studies have not focused on the effects of brief perceptual deprivation on ratings although some attempts were made to examine its effect on looking time and choice behaviour. The results reported in this study suggest that at least part of the reason for the increase in looking time may be due to a shift towards greater perceived complexity.

The prediction that hedonic value as reflected by the pleasingness ratings would increase as a function

of deprivation provided further support for hypothesis (2). Significant increases in hedonic value were found at all three complexity levels. This increase in hedonic value may also have contributed towards an increase in looking time.

Surprisingly, no significant differences were found between the control and Dep-30 groups despite increases in rated complexity and pleasingness. The ratings for the Dep-60 group were greater and proved to be significantly different from the control group. These results underscore the differing sensitivities of various measures of exploratory behaviour and point to the need for using several different measures in the context of a study.

One question that needs to be discussed deals with the underlying reasons for the changes in looking time and rating scales. Two theories attempt to deal with this question. One suggests a U-shaped function between arousal and arousal potential in which arousal increases from the optimal level as a result of upward or downward shifts away from intermediate levels of arousal potential. Berlyne (1960, 1963, 1967). The other theory postulates a linear relationship between arousal and arousal potential in which arousal decreases from the optimal level with decreases in arousal potential; Fiske & Maddi (1961), Zuckerman (1969). Berlyne's theory implies that an individual is aroused above the optimal level

as a result of stimulus deprivation and will act to reduce the arousal by increased exposure to stimuli which have been shown to increase arousal i.e. stimuli with greater arousal potential. However, studies examining the behaviour of subjects in whom arousal has been increased show that the subjects attempt to decrease their arousal level by decreasing the amount of incoming stimulation e.g. reducing looking time. The results of the white noise experiment in the present study clearly suggest the same thing. Further, the prediction of a downward shift of high complex stimuli toward a lower intermediate perceived level of complexity, which would provide some support for Berlyne's U-shaped function, was not born out since the shifts were in the opposite direction i.e. stimuli were perceived as more complex rather than less and were also found more pleasing.

Berlyne's theory is based to a large extent on the results of studies examining the effects of prolonged perceptual isolation which seemed to suggest that after prolonged isolation the subjects showed signs of increased arousal e.g. restlessness, agitation, desynchronisation of brain wave activity. Many subjects even reported various hallucinations. However, these changes took place after quite prolonged periods. Initially most subjects, after a brief interval during

which they attempted to maintain their level of arousal by concentrating on various problems (Heron, 1957), found that they were unable to maintain their arousal in this manner and frequently drifted off to sleep. This suggests that initially their arousal level decreased. Jones et al (1961) in his study on the effects of deprivation administered dexedrine to his subjects to keep them awake throughout the experiment. Despite that, the researchers felt that some subjects fell asleep anyway which may have influenced some of their results. The possible implication of these results is that there may exist two separate functions with different underlying parameters describing the relationships between arousal and arousal potential; a monotonically increasing function describing the relationship at brief and possibly intermediate levels of deprivation and an inverse relationship with more prolonged periods of deprivation.

The results of the present study show no evidence of a U-shaped function but do suggest a monotonically increasing relationship between arousal and arousal potential. Further investigation will be required to determine if two separate functions do in fact exist.

The relatively similar results obtained for looking time and the rating scales, suggest that a positive relationship exists between these measures of preference

and exploratory behaviour. An examination of the correlations revealed that this indeed is the case. All four of the rating scales were found to be positively correlated with looking time although not all the correlations reached significance. These results are in line with previous work; Leckart (1966), Gaschk et al (1968), Berlyne (1973), Russell (1975), Oostendorp & Berlyne (1978) who similarly found significant positive correlations between looking time and ratings of complexity, interest and hedonic value. The magnitude of the correlations was comparable to those found in the present study. e.g. Berlyne (1973) obtained correlations of .89, .83, and .58 for complexity, interest and hedonic value respectively; Berlyne (1975) obtained a correlation of .81 between complexity and looking time; Russell (1975) obtained correlations of .75 and .73 for complexity and interest respectively.

Arousal

It was found that the presentation of white noise resulted in a decrease in looking time at all three complexity levels, although the decrease just failed to reach significance for the mid complexity level. These results provide some support for the first part of hypothesis (3) and are in line with the findings of other researchers (Berlyne & Lewis 1963; Skrzypek

1967) who obtained decreases in the preference for complexity following increases in physiological arousal level as a result of external sources of stimulation. The present study goes further in demonstrating that preference reductions can occur with low complexity stimuli as well, if a sufficiently intense external source of arousal is employed.

No support was found for the second part of hypothesis (3), that the greatest decreases would be expected for high complex stimuli, since the interaction between complexity and arousal was not significant. This result was not expected and occurred despite the presumably greater arousal potential of the high complex stimuli. A possible reason for these results may be found in the verbal ratings. The increase in subjective complexity ratings for the high complex stimuli suggests that a perceptual change in the direction of greater perceived complexity may have occurred as a result of increased arousal. This increase in perceived complexity may have decelerated the reductions in looking time. On the other end of the complexity scale i.e. the low complex stimuli, there is no indication that a perceptual shift had taken place. However, a reduction in hedonic value did occur. Taken in combination, these two factors may have countered the predicted trend of

greater effectiveness at the high complexity level:

A comparison of all the groups revealed that concurrent stimulation resulted in the greatest decrements in looking time for all complexity levels, although the trend for mid complexity stimuli failed to reach significance. (See Fig. 6) These results provide support for hypothesis (4). The linear trends further suggest that the increments in arousal produced by the white noise decay fairly rapidly. White noise subjectively appears to be very simple and requires little cognitive processing. The level of cognitive processing prior to an exploratory response has been shown to influence subsequent exploratory behavior; Berlyne & Crozier (1971), Berlyne (1971). This study provides support for the idea that the stimulus intensity of an extraneous source may, by itself, regardless of the amount of information processing required, be sufficient to influence exploratory behaviour provided certain temporal requirements of presentation (in the case of white noise, concurrent presentation appeared to be the most effective) are met. Temporally inaccurate presentations of white noise may account, at least in part, for the difficulties some researchers have had in obtaining predicted effects.

A number of alternative explanations need to be considered with respect to the results obtained by concurrent presentations of white noise. One possibility is that the noise distracted the subjects resulting in a drop in looking time. Indeed 40% of the subjects in the concurrent group reported being distracted by the noise but only during the presentation of the first (trial) slide (Appendix E). An examination of the looking time scores for the sample slide revealed that the subjects reporting distraction had higher scores than the subjects reporting no distraction. These differences were apparent only for the sample slide. One possibility for the higher scores is that by the time the distracted subjects returned their attention to the slide the noise presentation was over or nearly over. As a result, the effectiveness of the white noise may have been reduced. This possibility cannot, however, be verified since no measures were taken of the period of distractability. Regardless of the reasons for the higher scores, the possibility that the looking time scores decreased as a result of distractability appears unlikely.

Another possibility for the drop in looking time may have been the subjects' desire to terminate the trials as quickly as possible since they all found

the noise to be very unpleasant (Appendix E). If this were indeed the case, one would expect few if any differences in looking time between the slides, regardless of complexity. In fact, no evidence of this was found. Although the looking time scores were lower, the pattern of scores was very similar to that of the other groups i.e. the subjects were clearly attending and responding to the perceived complexity of the slides (See Fig. 6).

With respect to the rating scales it was found that the hedonic value of the stimuli decreased as arousal increased, i.e. an inverse relationship, with the most pronounced decrease occurring for the concurrent group. These results provide support for the first part of hypothesis (5). Other researchers, Berlyne (1970, 1971), Day (1967), Wohlwill (1968) found that as the arousal potential of a stimulus increases to high levels a drop in preference and in hedonic value takes place. The present study differs in this respect, that the arousal potential of the stimuli remained constant. Rather, physiological arousal was manipulated extrinsically through the use of white noise. This had the advantage of allowing the observation of the impact of increased arousal on the ratings of stimuli ranging from low to high complexity. Berlyne (1970), Phelan (1970) found

that with repeated presentations the hedonic value of a stimulus decreases and this is reflected in lowered hedonic ratings. The findings of the present study provide further support that some ratings, particularly hedonic ratings, are not stable and may also be influenced by the momentary activation level of the individual. The subjective arousal and complexity ratings also demonstrated some shifting, although in the opposite direction to that of the hedonic ratings, possibly due to a perceptual shift.

No support was obtained for the second part of hypothesis (5) that the hedonic changes were expected to be more pronounced at the high complexity level. In fact, significant downward shifts occurred at all three complexity levels. Previous research has suggested that hedonic value increases with judged complexity; Wohlwill (1968), Breuer & Lindauer (1976), Berlyne (1973), Nicki & Gale (1977), Oostendorp & Berlyne (1978). The present study provides further support for these results and in addition suggests that despite an increase in arousal the pattern of ratings remains relatively stable i.e. although a general decrement in hedonic value occurred the high complex stimuli were still rated to be the most pleasing and the low complex stimuli the least. It remains to be seen in subsequent studies whether this

pattern is specific to the stimuli used in the present experiment or it has general validity with other stimuli as well.

An investigation of the relationships between looking time and the rating scales revealed that all four scales were positively correlated with looking time. This is similar to the results obtained in the first experiment. Once again the magnitude of the correlations was comparable to that of previous studies.

Individual Differences

Significant positive correlations between complexity preference (% looking time) and the Experience Seeking and Total scales of the SSS were found for high complex stimuli. Despite the relatively low correlations these results provide at least partial support for Osborne and Farley's (1970) hypothesis of a significant relationship between complexity preference and the SSS. As in their study, however, no significant relationship was found between complexity preference and the extraversion scale. In fact the correlations were found to be quite low. The results of both studies suggest that despite the fact that consistent significant correlations are obtained between the SSS and the extraversion scale of the EPI, the latter scale has not shown itself to be a predictor of complexity

preference.

A comparison of high and low sensation seekers in terms of their looking times revealed significant linear trends for low and high complex stimuli to the extent that high sensation seekers spent a greater proportion of their time fixating the high complex stimuli than the low sensation seekers. The inverse of this was found for low complex stimuli where the low sensation seekers spent a greater proportion of their time fixating the low complex stimuli than the high sensation seekers. These results provide some support for hypothesis (6) and are in line with the Zuckerman et al (1964) theory that individual differences in optimal arousal lead to differences in stimulus seeking behaviour. The SSS was developed for the purpose of assessing individual differences. The results of the present study suggest that the latest version of the SSS, form V, may be useful in predicting the direction and intensity of exploratory behaviour. With further refining the SSS could prove to be an excellent tool for measuring individual differences in optimal arousal.

The hedonic ratings are more difficult to interpret as a result of subject variables. However, the available results do suggest that high sensation seekers find high complex stimuli more pleasing than low complex

stimuli, providing partial support for hypothesis (7). The results for low sensation seekers seem to point in the same direction, however, the lack of low sensation seekers in the Dep-30 and Dep-60 groups makes the interpretation of the results difficult and potentially invalid. Subsequent research will have to focus on this question. One possible way of avoiding the problem in future experiments is to preselect the subjects on the basis of their sensation seeking scores.

Summary and Conclusions

The current study focused on the effects that brief perceptual deprivation as well as increases in physiological arousal may have on exploratory behaviour. The results suggest that both conditions affect exploratory behaviour although in opposite directions. Deprivation leads to increases in exploration as the subject seeks stimulation in order to increase his arousal level to optimal conditions. The further away from the optimal level the greater the increases in perceived complexity, hedonic value and subjective arousal when a stimulus is finally presented.

An increase in arousal above the optimal level on the other hand, leads to decrements in exploration as the individual seeks to return to the optimal level by reducing stimulus input. Although perceived

complexity and subjective arousal undergo an upward shift, hedonic value decreases with increases in arousal.

Two theories which may account for the findings of this study were discussed and it was concluded that the evidence did not support Berlyne's U-shaped function relating arousal to arousal potential. The possibility of two different functions with differing parameters was raised to account for changes stemming from brief and prolonged perceptual deprivation.

The present study differs from previous work in that it placed much greater emphasis on the subjective impressions (i.e. the ratings) of subjects. Previous studies made no systematic attempts to determine the impact on those impressions of externally manipulated increases or decreases in arousal. The findings of this study suggest that the perceived arousal potential of stimuli may be much more subjective than previously thought and to a point relative to the momentary arousal level of the individual.

The results also suggest that the relationships between the various measures of exploratory behaviour remain relatively stable regardless of increases or decreases in the arousal level of the individual.

With respect to personality variables some evidence in support of a relationship between the SSS

and preference for complexity was found. As well, a trend for differential exploratory tendency was noted as a function of high and low sensation seeking suggesting that the SSS may have some potential for predicting the direction and possibly the strength of the exploratory response. The Extraversion scale was found to correlate positively with the SSS, however, no apparent relationships between the E-scale and the measures of exploration employed in this study were found.

Future research might focus further on the relationship between sensation seeking, exploration and arousal. Rating shifts also need to be examined further. As discussed earlier, repeated presentations lead to such shifts. Changes in arousal below or above the optimal level also appear to lead to such shifts. The question that then arises is whether shifts due to arousal change are transitory or do they have some impact on subsequent exposures of the same material when it is presented under different conditions. This question is particularly relevant in view of the constant stimulus bombardment that individuals face in interacting with their environment. It may also be of considerable interest to researchers in the area of marketing and advertising as well as architecture.

APPENDIX A
STIMULUS MATERIAL

Stimulus Material

The stimulus material consists of 15 slides of nonrepresentational art which were selected from a larger set of 50 slides. The entire set was prepared in a pilot study in which 16 Ss viewed all the slides and rated them with respect to complexity using a scale ranging from 1 as the least complex to 9 as the most complex. The fifteen slides represent three levels of complexity; low, medium and high with 5 at each level and were selected because of their high intersubject rating consistency as measured by the standard deviation. The slides and their complexity scores are presented in Table A.

TABLE A

ART SLIDES UTILIZED AT DIFFERENT COMPLEXITY LEVELS

COMPLEXITY LEVEL	DESCRIPTION OF SLIDE	COMPLEXITY MEAN	RATINGS S.D.
LOW	Dan Van Severen: Composition (1961-1962)	1.88	0.96
	Joseph Ongenae: Lozenge (1957)	2.50	1.41
	Jo Delahaut: Proposition I	2.25	1.00
	Georges Vantongerloo: Composition XV	2.19	1.11
	Josef Albers: Homage to the Square	2.38	0.81
MEDIUM	Luc Peire: Solitude	5.13	1.45
	Felix De Boeck: Composition 8	5.31	1.54
	Gaston Bertrand: Composition No. 85	4.87	1.41
	Victor Servranckx: Opus 38	5.13	1.59
	Fritz Glarner: Tondo No. 38	4.88	1.09
HIGH	Georges Collignon: Hope of Shock	8.19	1.05
	Victor Servranckx: Opus 11	7.94	1.39
	Wassily Kandinsky: Development in Brown	7.69	1.01
	Marcel Duchamp: Nude Descending a Staircase	7.81	1.38
	Ben Cunningham: The Tesseract	7.63	0.89

APPENDIX B
RATING SCALES

RATING SCALES

Extremely
simple

— — — — —

Extremely
complex

Extremely
uninteresting

— — — — —

Extremely
interesting

Extremely
displeasing

— — — — —

Extremely
pleasing

Extremely
non-arousing

— — — — —

Extremely
arousing

APPENDIX C

ANALYSIS OF VARIANCE OF INTERSTIMULUS

DIFFERENCES FOR LOW, MEDIUM AND HIGH

COMPLEXITY

TABLE B

ANALYSIS OF VARIANCE OF INTERSTIMULUS DIFFERENCES FOR
LOW, MEDIUM AND HIGH COMPLEXITY

SOURCE OF VARIATION	df	LOW COMPLEXITY			MED COMPLEXITY			HIGH COMPLEXITY		
		SS	MS	F	SS	MS	F	SS	MS	F
BETWEEN SUBJECTS	29	.068			.070			.0545		
DEPRIVATION (D)	2	.024	.012	7.5**	.018	.0090	4.74*	.0125	.00625	3.91*
ERROR BETWEEN	27	.044	.0016		.052	.0019		.042	.0016	
WITHIN SUBJECTS	120	.018			.022			.015		
STIMULUS SLIDES (S)	4	.001	.00025	1.79	.001	.00025	1.32	.0007	.00018	1.46
D X S	8	.002	.00025	1.79	.001	.00013	.66	.0017	.00021	1.77
ERROR WITHIN	108	.015	.00014		.020	.00019		.0126	.00012	

* $p < .05$ ** $p < .01$

TABLE C
ANALYSIS OF VARIANCE OF INTERSTIMULUS DIFFERENCES FOR
LOW, MEDIUM AND HIGH COMPLEXITY

SOURCE OF VARIATION	df	LOW COMPLEXITY			MED COMPLEXITY			HIGH COMPLEXITY		
		SS	MS	F	SS	MS	F	SS	MS	F
BETWEEN SUBJECTS	39	.845			.380			.338		1.29
AROUSAL (A)	3	.167	.056	2.95*	.038	.013	1.37	.033	.011	
ERROR BETWEEN	36	.678	.019		.342	.0095		.305	.0085	
WITHIN SUBJECTS	160	.409			.321			.447		
STIMULUS SLIDES (S)	4	.020	.0050	2.08	.009	.0023	1.21	.016	.004	1.43
A X S	12	.047	.0039	1.63	.037	.003	1.58	.027	.0023	.82
ERROR WITHIN	144	.342	.0024		.275	.0019		.404	.0028	

* $p < .05$

APPENDIX D

ANALYSIS OF VARIANCE OF DIFFERENCES IN PROPORTIONS
OF LOOKING TIMES ACROSS
CONTROL, DEPRIVATION AND AROUSAL GROUPS

TABLE D
ANALYSIS OF VARIANCE OF DIFFERENCES IN PROPORTIONS OF LOOKING TIMES
ACROSS CONTROL, DEPRIVATION AND AROUSAL GROUPS

SOURCE OF VARIATION	df	SS	MS	F
BETWEEN SUBJECTS	59	.010		
PROPORTIONS	5	.001	.0002	1.18
ERROR BETWEEN	54	.009	.00017	
WITHIN SUBJECTS	120	6.571		
COMPLEXITY	2	3.890	1.945	77.80***
P X C	10	.0310	.0031	.124
ERROR WITHIN	108	2.650	.025	

*** $P < .001$

APPENDIX E

QUESTIONNAIRE RESPONSES

PLEASE ANSWER THE FOLLOWING QUESTIONS:

1. What do you think was the purpose of this experiment?
2. Did you make any attempts to memorize the slides?
3. What do you think was the purpose of the noise?
4. Did you find that the noise distracted you? ie. made you look away from the slides when they were presented?
5. Please rate the noise by selecting one of the following choices:
noise was: painful _____
very unpleasant _____
mildly unpleasant _____
pleasant _____

QUESTIONNAIRE

All subjects were asked to respond to a series of written questions following completion of the task.

Their responses were as follows:

1. What do you think was the purpose of this experiment?

- 100% of the subjects in all the groups accepted experimenter's explanation.

2. Did you make any attempts to memorize the slides?

- None of the subjects claimed to have made the attempt.

3. What do you think was the purpose of the noise?

Looking time task

- 80% of the subjects from the Pre "15" and Pre "0" groups accepted experimenter's explanation.
- 20% thought that noise was used as signal for slide presentation.
- 70% of the Concurrent group subjects accepted experimenter's explanation;
- 20% thought it was some kind of interference;
- 10% thought its purpose was to annoy the subject.

Rating Task

- 85% of the Pre "15" and Pre "0" group subjects accepted experimenter's explanation;
- 15% thought that noise was used as signal for slide presentation;
- 80% of the Concurrent group subjects accepted experimenter's explanation;
- 20% thought it was used as a source of interference.

4. Did you find that the noise distracted you; ie. made you look away from the slides when they were presented?
- 100% of the Pre "15" and Pre "0" subjects reported no distraction;
 - 60% of the subjects in the Concurrent groups reported no distraction;
 - 40% reported distraction to the first (trial) slide but not to subsequent slides.
5. Please rate the noise by selecting one of the following choices:

noise was: painful 0%

very unpleasant 100%

mildly unpleasant 0%

pleasant 0%

- All of the subjects found the noise to be very unpleasant.

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